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16. ABSTRACT

The February 1976 - April 1976 Oil Spill and Oil Pollution Reports is the seventh quarterly compilation of oil spill events and oil pollution report summaries. Presented in the report are: (a) summaries of oil spill events; (b) summaries and bibliographic literature citations; (c) summaries of current research projects; and (d) patent summaries. This report is submitted in partial fulfillment of EPA Grant No. R-803992 by the Marine Science Institute, University of California, Santa Barbara, under the sponsorship of the Environmental Protection Agency.

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OIL SPILL AND OIL POLLUTION REPORTS

February 1976 - April 1976

by

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FOREWORD

When energy and material resources are extracted, processed, converted, and used, the related pollutional impacts on our environment and even on our health often require that new and increasingly more efficient pollution control methods be used. The Industrial Environmental Research Laboratory - Cincinnati (IERL-Ci) assists in developing and demonstrating new and improved methodologies that will meet these needs both efficiently and economically.

This report is a product of the above efforts. It cites current events, literature, research, patents, and other material relevant to the oil pollution abatement program and is published in an abstract format on a quarterly basis. As such, it serves as a basic reference document for all those interested in oil spill and oil pollution control. This project is part of the continuing program of the Oil and Hazardous Materials Spills Branch, IERL-Ci to assess and mitigate the environmental impact of oil pollution.

David G. Stephan
Director
Industrial Environmental Research Laboratory
Cincinnati

ABSTRACT

OIL SPILL AND OIL POLLUTION REPORTS is a quarterly bulletin designed to review current scientific and technical publications and research projects in the field of oil pollution. Subject scope includes all aspects of aquatic and terrestrial oil pollution. This issue contains summaries of research projects and documents selected from the scientific and technical literature during the period February, 1976 through April, 1976.

The following sections are included in the report:

I. Reports, Publications, and Patents
II. Current Research Projects
III. Current Oil-Related Conferences

This report is submitted in partial fulfillment of EPA Grant No. R803992-01 by the Marine Science Institute, University of California, Santa Barbara, California, under the sponsorship of the Environmental Protection Agency.

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INTRODUCTION

OIL SPILL AND OIL POLLUTION REPORTS is a quarterly bulletin which reviews pertinent scientific and technical publications and research projects to provide its readers with current developments in the field of oil pollution. This issue contains summaries of articles, reports, documents, and other materials relating to oil pollution published during the period 1974 to 1976 (Section I); summaries and status of current research projects (Section II); and current oil-related conferences (Section III).

The subject scope includes all aspects of aquatic and terrestrial oil pollution. Items in Section I are categorized by seven major subdivisions divided into thirty-four specific subject categories. These are presented in the Table of Contents. Patents and patent applications are announced in this section under appropriate subject categories. Sources of the citations appear in the list of Periodicals Reviewed in the Appendix. A subject index for entries in Section I is provided at the end of the report.

Section II presents titles of active or recently completed oil pollution research projects, summaries of project objectives, and current status information and/or resulting publications provided upon request by the principal investigators or performing organization. Notices of research projects were obtained from the Smithsonian Science Information Exchange (SSIE), Maritime Information Research Service, Aquatic Microbiology Newsletter, and individual researchers. Entries are arranged according to the same subject categories as in Section I and are ordered by serial number within each subject division. Some of the current projects listed in previous Oil Pollution Reports have been recently renewed. These projects have been relisted and headed by the same serial number as originally reported, followed by the word (renewal). Renewal entries are listed at the beginning of each subject category.

Section III, Current Oil-Related Conferences, contains descriptive information on recent and future conferences relating to environmental oil pollution. Conference dates are listed; and, when information is available, titles, authors, and abstracts of conference papers are included. All information for this section was obtained from the periodicals reviewed (Appendix) and from responses to personal inquiries concerning the symposia.

Sections I and II have their own serial numbers. The letters preceding the serial numbers designate the following: C, reports, publications, and patents; and R, research projects. The subject content of many of the items pertains to more than one subject category, in which case additional categories are included with the summary.

SECTION I. REPORTS, PUBLICATIONS, AND PATENTS

A. OIL POLLUTION DETECTION AND EVALUATION

1. REPORTING

C-630-76
No title given (news brief)

Anon. 1976.
Audubon 78(2):143.

Despite an international agreement on right-hand driving in the English Channel, vessels do not always comply with the rules. On a foggy day, a frigate and a tanker collided due to their maneuvers to avoid 2 ships travelling on the wrong side. Some 13,000 tons of oil were spilled as a result.

Oil transfer and transport, International legislation

C-631-76
API CONTINUES ENVIRONMENTAL RESEARCH (news brief)

Anon. 1976.
Offshore 36(3):128.

API's total 1976 research budget is $2.89 million. Research on the effects of oil on the marine environment, oil pollution prevention and control, solid waste management and water quality control will be funded.

General effects of oil pollution

C-632-76
CHEMICAL TESTS NAIL OIL SPILL SUSPECT

Anon. 1975.
Chemical & Engineering News 53(46):7.

The vessel that discharged more than 40,000 gallons of crude oil near Key West, Florida on July 18, 1975, was identified by matching the oil from the spill with an oil sample taken from the ship. Samples from 250 suspect ships were analyzed by Coast Guard and EPA chemists using thin-layer chromatography, ultraviolet spectrofluorometry, capillary column gas chromatography, etc. The captain faces a fine of $10,000 and up to one year in federal prison.

Source identification

C-633-76
ENVIRONMENTAL ACTION (news brief)

Anon. 1975.
Petroleum Engineer International 47(12):EM6.

According to National Water Council figures, it will cost $220 billion by 1983 to meet 1972 water pollution standards. A study on refinery pollution control estimated that the U.S. oil industry will have to spend $3 to 4 billion by 1983 to comply with federal pollution control regulations. The American Petroleum Institute stated that this amount covered only 55% of the refinery pollution control costs.

Economic effects of oil pollution

C-634-76
GRADING THE REFINERS ON POLLUTION (news brief)

Anon. 1975.
Chemical Week 117(26):11.

The report "Cracking Down," issued by the Council on Economic Priorities, profiles 61 refineries, ranking them on their discharges of air or water pollutants and noting their compliance with state or federal pollution laws. Standard Oil of California and Atlantic Richfield have the best air pollution control records and Shell has the best water pollution ranking. Texaco is the worst air polluter and Gulf has the poorest water pollution ranking.

Industry standards and guidelines

C-635-76
OIL IN THE SEA

Anon. 1975.
The Dock Harbour Authority 55(651):323.

The U.S. National Research Council reports that of six million tons of petroleum hydrocarbons entering the world's oceans per year, about 35% come from transportation activities, 31% from river runoff, 13% from coastal refineries and municipal and industrial wastes, 10% from natural seepage, and 1.3% from offshore oil operations. Tar masses have appeared in formerly unpolluted areas worldwide. They are caused by tanker washings and bilge discharges.

General fate of oil in the environment

C-636-76
OIL SPILLS AND MONITORING: OIL TRANSPORT PROCEDURES MAY BE CHANGED

Anon. 1975.
Marine Technology Society Journal 9(10):43-44.

In January, 1975, a team of U.S. scientists conducted a study on the effects of the "Metula" oil spill, in which 50,000 tons of oil were spilled into the Magellan Strait. An international group of environmentalists met in Boulder, Colorado, to discuss the findings of the study and to consider long-term effects. The team concluded that "essentially all" of the oil that had floated onto the shore was still there and the biological impact of the spill was severe.

Biological effects of oil pollution, Monitoring, Oil transfer and transport

C-637-76
OIL TERMINAL SPILL AT BANTRY BAY

Anon. 1975.
Pollution Monitor (23):13-16, 43.

In October of 1974, an overlooked open valve on the tanker "Universe Leader" was the cause of a 2500-ton oil spill. This spill was one of many, including another at Bantry Bay, where a tanker was punctured by a tug. In this report, the measures taken to minimize the risk of recurrence and the cleanup procedures used are discussed.

Cleanup and recovery

C-638-76
SHELL TELLS ALL ON THE GROUNDING OF METULA

Anon. 1975.
Marine Engineering/Log 80(4):54-55.

Shell International Marine recently told a marine industry audience the details of the grounding and salvage of the VLCC "Metula" in the Magellan Straits. The logistics problems and the plan for preventing more pollution and refloating the "Metula" are detailed. Due to the weather patterns and the isolation of the area, pollution effects were minimal.

General effects of oil pollution

C-639-76
NAPHTHA LEAKAGE AT PUR FLEET AND SPILLAGE OF LEADED FUEL AT SOUTH STIFFORD, ESSEX

Aspinwall, R. 1974.
Groundwater Pollution in Europe. J. A. Cole (ed.). Conference of the Water Research Association, Reading, England, 1972. p. 338-343.

The sequence of events following the first notification that naphtha leakage was occurring, the effectiveness of the measures taken to combat pollution, and the cooperation between local authority, the petroleum company and the River Authority are reviewed. An example entailing spilled leaded petroleum in rail sidings is also reviewed.

Oil transfer and transport

C-640-76
PETROLEUM AGGREGATES IN THE SURFACE WATERS OF THE MEDITERRANEAN

Benzhitskij, A. G., and G. G. Polikarpov. 1975.
Radiochemoecological Studies in the Mediterranean Sea (70th cruise of the R/V 'Akademik Kovalevskij' in May-July 1972). G. G. Pokikarpov (ed.). Kiev, USSR, Naukova Dumka, 1975.

The central and western areas of the Mediterranean Sea were sampled with a neuston net in order to determine the quantitative distribution of petroleum aggregates. Maximum pollution was found in the coastal areas of the Ionian, Tyrrhenian and Ligurian Seas (6.23, 5.78 and 4.33 mg/m^2). Minimum pollution was observed in the Black and Aegean Seas. Some sizes of aggregates were covered with periphyton.

General fate of oil in the environment

C-641-76
A RECENT CASE HISTORY OF GROUNDWATER POLLUTION BY ORGANIC SOLVENTS

Day, J. B. W. 1974.
Groundwater Pollution in Europe. J. A. Cole (ed.). Conference of the Water Research Association, Reading, England, 1972. p. 346-347.

Severe pollution of groundwater near public supply sources was discovered in 1969. The source of pollution was probably leaking underground effluent drains. "Suction scavenge pumping" was used to clear the body of polluted groundwater. Solvent concentrations decreased over the year to acceptable levels.

Waste treatment and disposal methods

C-642-76
OIL POLLUTION ALONG THE INDIAN COASTLINE

Dwivedi, S. N., and A. H. Parulekar. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop, National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.). NBS Special Publication No. 409. p. 101-105.

The areas, seasons and intensity of deposition of tar balls along Indian beaches and their possible origin were studied. Oil pollution is not uniform but is widespread on both coasts. The tar balls appear to come from the oil wastes and ship spillage discharged by oceangoing vessels.

Source identification, Monitoring

C-643-76
PETROLEUM POLLUTION AT GREAT HOSPITAL, NORWICH

Funnell, B. M., and G. S. Boulton. 1974.
Groundwater Pollution in Europe. J. A. Cole (ed.). Conference of the Water Research Association, Reading, England, 1972. p. 344-345.

A series of pollution incidents near the Great Hospital boiler works involving light petroleum distillate is reviewed. No remedial action has yet been taken. The immediate danger is not to the water supply, but that of fire risk.

General effects of oil pollution

C-644-76
OIL POLLUTION FROM THE TANKER "METULA"

Hann, R. W., Jr. 1974.
Texas A & M University Report. 61 p.

The VLCC "Metula" ran aground in the Straits of Magellan in August, 1974, and lost 51,500 tons of oil. The effects of this spill on the shore and the organisms, and the feasibility of cleanup/containment operations are discussed. This spill taught those involved that spills can happen, even with superships, that present cleanup methods are for small spills, and that keeping superports offshore helps provide reaction time.

Biological effects of oil pollution, Cleanup and recovery

C-645-76
THE POLLUTION OF PORTS

Houghton, D. R. 1975.
Conference on Pollution Criteria for Estuaries, University of Southampton, U.K., 1973. P. R. Helliwell, and J. Bossanyi (eds.). London, Pentech Press Ltd., 1975. p. 8.1-8.10.

Oil pollution, accidental spillage of toxins and the polluting effects of various anti-fouling paints are considered. Copper from these paints and heavy metals from the sewage are potential pollution hazards, especially in enclosed docks.

General effects of oil pollution

C-646-76
CRACKING DOWN, OIL REFINING AND POLLUTION CONTROL

Kerlin, G., and D. Rabovsky. 1975.
New York, Council on Economic Priorities, 1975. 478 p.

This book reviews who has the best and worst air and water pollution control records, the technology developed, and how pollution control can result in cost, material and energy savings. The role of governmental enforcement in pollution control is also discussed.

General effects of oil prospecting and production, Industry standards and guidelines

C-647-76
OIL GLOBULES AND THEIR ATTACHED ORGANISMS IN THE EAST CHINA SEA AND THE KORUSHIO AREA

Marumo, R., and K. Kamada. 1973.
Nippon Kaiyo Gakkai-Shi 29:155-158. (Translated from Japanese, Fisheries and Marine Service, Translation Series No. 3389, 1975)

In May 1971, oil globules were found in the surface waters along 125°E. They occurred predominantly in the upper 4 m; the highest concentration was at 125°E 28°N. Blue-green algae (2 species of Trichodesmium), pennate diatoms, stony corals, bryozoans, barnacles and copepods were associated with the oil.

Biological effects of oil pollution

C-648-76
HYDROCARBONS IN THE SOUTHERN AEGEAN SEA

Sonnenfeld, P. 1974.
Annales Geologiques des Pays Helleniques 25:215-224.

No major accumulation of hydrocarbons has yet been found in the southern Aegean Sea. This review has 57 references.

Monitoring

2. MONITORING

C-649-76
DETECTING OIL LEAKS

Anon. 1975.
Electronic Instrumentation 5(11):6-9, 12.

The detection of oil or hydrocarbons specifically can only be done with infrared devices. A recently developed instrument responds only to compounds which have CH_2 and CH_3 groups. These include a number of gases, and solid and liquid hydrocarbons. This automated analyzer can be used on industrial streams and on natural bodies of water.

Design and engineering

C-650-76
DIRECTORY OF INSTITUTIONS ENGAGED IN POLLUTION INVESTIGATIONS: CONTAMINANTS IN AQUATIC ORGANISMS

Anon. 1974.
FAO Fisheries Circular 325. 49 p.

The addresses of 233 institutions in 48 countries are presented. The activities of the institutions are classified as marine, freshwater, monitoring, and by geographical area and habitat of the organism studied. The contaminants being analyzed are also cited; they include petroleum hydrocarbons, metals, radioactive substances, halogenated hydrocarbons, etc.

Analysis, Biological effects of oil pollution

C-651-76
NOAA FLEET TO MONITOR OIL POLLUTANTS

Anon. 1975.
Marine Technology Society Journal 9(10):44-45.

A 25-ship NOAA fleet has been organized as a part of the UN program Integrated Global Ocean Station System (IGOSS) to monitor slicks and other oil pollutants in inshore and offshore waters of the Atlantic Ocean, Gulf of Mexico, Pacific Ocean and Bering Sea. Vessels will also collect samples of oil tar balls for analysis so that periodic assessments can be made of the state and degree of ocean contamination.

General fate of oil in the environment, Analysis

C-652-76
OCEAN OIL-HOUND FOLLOWS SCENT OF FUEL BELOW SEA

Anon. 1976.
National Fisherman 56(9):5-B.

The "Suffolk Shore," called the "Gas Sniffer" by her crew, tows instruments over the stern that collect and record hydrocarbon content in the water. These data inform researchers of oil or gas seeping from the ocean floor or leaking from a sunken vessel, or of discharges of oily bilges.

Design and engineering

C-30-76
QUANTITATIVE MONITORING AND AVAILABILITY OF PELAGIC TAR IN THE NORTH ATLANTIC

Butler, J. N., and B. F. Morris. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop, National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.). NBS Special Publication No. 409. p. 75-78.

Sampling with a neuston net for pelagic tar gives results that vary by a factor of 10. Thus, elaborate flow measurements, etc., are not useful. The IOC-WMO recommendation that dry weight be determined involves unnecessary labor. Wet weight measurements are adequate.

Sampling, General fate of oil in the environment, Analysis

C-31-76
MARITIME CONSIDERATION OF OIL TRANSPORTATION

Casey, H. F. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop, National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.). NBS Special Publication No. 409. p. 33-40.

The pollution abatement programs of Mar Ad (Maritime Administration) are discussed in relation to four major U.S. laws. One of the most significant programs is subsidized tanker construction which includes anti-pollution design features. Mar Ad is also involved in gathering baseline information to be used in formulating oil discharge regulations for ships.

U.S. legislation, Oil transfer and transport

C-653-76
MOLECULAR TEST FOR OIL POLLUTION IN SURFACE SEDIMENTS

Dastillung, M., and P. Albrecht. 1976.
Marine Pollution Bulletin 7(1):13-15.

Polycyclic hydrocarbons of biological origin can be used as pollution indicators in crude oil pollution studies. Their use is based on differences in distribution patterns of pentacyclic triterpanes between immature and mature sources. A study of a weakly polluted surface sediment from the West Coast of France is described.

C-654-76
BIOGENOUS HYDROCARBONS IN THE SOIL [English summary]

DeBorger, R., and Y. Van Elsen. 1974.
Landbouwkundig Tijdschrift (Brussel) 27(6):1483-1489.

The study concerned the quantitative and qualitative determination of soil pollution by mineral oil products and hydrocarbons naturally present in sand, loam and clay soils. Combinations of hydrocarbons with an odd number of carbon atoms were found; C29 and C33 occurred in highest concentrations.

Source identification

C-655-76
USE OF MUSSELS IN ESTIMATING BENZO[A]PYRENE CONTAMINATION OF THE MARINE ENVIRONMENT

Dunn, B. P., and H. F. Stich. 1975.
Proceedings of the Society for Experimental Biology and Medicine 150(1):49-51.

Mussels collected from various areas on the west coast of Vancouver Island were analyzed for benzo[a]pyrene. Those mussels near high levels of industrial, urban and recreational (power boat) activity had the highest concentrations. The level of benzo[a]pyrene in mussels may be a simple indication of the degree of polycyclic aromatic hydrocarbon contamination.

Analysis

C-656-76
OPTIMIZATION AND EVALUATION OF A FLUORESCENCE OIL SPILL DETECTOR. VOLUME 2. PROTOTYPE DESIGN

Eldering, H. G., and W. A. Webb. 1975.
Final Report, No. 5/75-62633-Vol-2 USCG-D-109-75, Contract DOT-CG-43845-A. 30 p. [AD-A016 464/OGA]

The operational and technical requirements of a low cost harbor surveillance unit are discussed. Consideration of coverage during the design of a Scanning Oil Spill Detector resulted in a design containing both azimuth and elevation scanning. This design costs less than the addition units to provide the increased coverage.

Design and engineering, Remote sensing

C-657-76
PETROLEUM OIL DETECTION BUOY SYSTEM

Gram, H. R. 1975.
Final report, No. 0250 USCG-D-39-75, Contract DOT-CG-43345. 37 p.
[AD-A016 461/6GA]

The floating buoy uses fluorescent techniques to detect petroleum oils ranging in composition from crude to kerosene. The buoy is powered by a land based power supply. Ultraviolet radiation is used to excite the oils. The resulting radiation in the near ultraviolet and blue end of the spectrum is detected and sets off an alarm. The mechanical packaging has been improved.

Design and engineering, Remote sensing

C-658-76
OIL SPILL PREVENTION BY EARLY DETECTION OF OIL ON WATER

Grillo, P. H. 1975.
International Seminar and Exposition on Water Resources Instrumentation, Chicago, Illinois, 1974. R. J. Krizek, and E. F. Mosonyi (eds.). Ann Arbor, Michigan, Ann Arbor Science Publishers, 1975. Vol. 2. Data Acquisition and Analysis. p. 536-552.

An oil-on-water detector floats on the surface and is able to "see" traces of surface oil in all kinds of weather and lighting conditions. The remote control unit can be installed one mile from the floating detector, which transmits light and then detects reflected light. When the reflected light intensity exceeds a certain threshold, an alarm is triggered. Regulations related to oil-on-water detection are discussed.

Design and engineering, U.S. legislation

C-46-76
SURVEY ANALYSES FOR PETROLEUM DERIVED HYDROCARBONS IN THE OCEAN

Hori, S. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop,

National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.).
NBS Special Publication No. 409. p. 27-28.

The activities of scientists in Japanese government organizations related to quantitative measurement of oil in the ocean are described. Oil residues in larval samples, tar ball distribution, and chemical analyses of petroleum hydrocarbons in seawater and sediment samples have been studied.

Sampling, Analysis, General fate of oil in the environment

C-659-76
METHOD AND APPARATUS FOR DETERMINING A FLUID CONTAMINANT

Hubby, L. M. 1975.
British Patent 1,418,130

The apparatus used to detect a contaminant having a different density than that of the stream consists of a U-tube with an inlet leg of which a fluid column is derived from the stream, and an outlet leg having a fixed height. The method is able to determine a change in inlet leg height which is an indication of the presence of the contaminant in the liquid stream.

Design and engineering

C-660-76
CONFERENCE OF THE INTERNATIONAL ASSOCIATION ON WATER POLLUTION RESEARCH, 7TH, PARIS, SEPTEMBER, 1974

Lakey, J. R. A. 1974.
Royal Naval College, Department of Nuclear Science and Technology, RNC-NS-TM-154. 12 p.

Topics of conference papers that are reviewed include sea disposal of sewage, pollution monitoring (oil), modelling, estuarine problems, technology transfer, legal aspects and water reclamation.

General effects of oil pollution

C-54-76
VALUE OF OIL POLLUTION MONITORING IN MARINE ORGANISMS

LaRoche, G. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop, National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.).
NBS Special Publication No. 409. p. 249-250.

Before monitoring can be successful, harmful fractions must be identified, and a range of biologically or esthetically tolerable concentrations of tainting products must be established. The author suggests that intensive coordinated efforts be made by the world scientific community to find the answers to these questions.

Biological effects of oil pollution

C-661-76
APPARATUS AND METHOD FOR DETERMINATION OF OIL ON WATER

Lins, J., and H. Kronenberger. 1975.
German Offenlegungsschriften (unexamined patent application) 2,354,125

Oil on water is monitored by a floating television camera in which the normal state video signal is stored. The monitoring signal is compared with the normal state video signal and any deviation on the water surface initiates an alarm.

Design and engineering

C-662-76
TECHNIQUES FOR POLLUTION CONTROL IN ESTUARIAL WATERS

Mackay, D. W. 1975.
Conference on Pollution Criteria for Estuaries, University of Southampton, U.K., 1973. P. R. Helliwell, and J. Bossanyi (eds.). London, Pentech Press Ltd., 1975. p. 11.1-11.20.

The problems involved in monitoring and accurately detecting well dispersed pollutants are discussed. The types of pollution reviewed include sewage, organochlorine, oil, beach and metal. New measurement and sampling techniques, such as the necessity of sampling the air-water interface in cases of small oil input, are stressed.

Sampling

C-663-76
MONITORING DISSOLVED HYDROCARBONS AS A FUNCTION OF THE TIDAL CYCLE (NEW YORK HARBOR)

McGowan, W. E. 1975.
Coast Guard Research and Development Center, CGR/DC-4/75 USCG-D-106-75. 39 p. [AD-A015 882/4GA]

Dissolved hydrocarbons (C1-C4) were measured as a function of the tidal cycle. Samples were taken from two to three feet below the surface and analyzed with a gas chromatograph. The monitoring system operated with a field error of less than 20%. The data show the hydrocarbon concentration to vary (6 times) over the tidal cycle. A knowledge of the tidal pattern is essential in determining a "sampling window" and interpreting monitoring data.

Analysis, Sampling

C-664-76
DETECTION AND MEASUREMENT OF POLLUTANTS OF WATER SURFACES

McMullen, A. I., J. F. Monk, and M. J. Stuart. 1975.
American Laboratory 7(2):87-92.

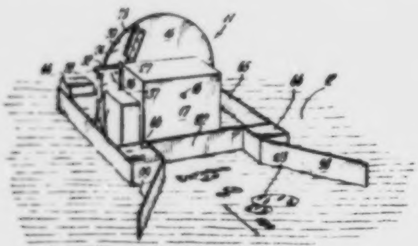
A floating microbalance continually monitors the surface tension of water and the level of pollutants such as oil, raw sewage and detergents. Examples of its uses are given.

C-665-76
OIL SPILL DETECTION SYSTEM

Miller, G. H., and E. O. Renick. 1975.
U.S. Patent 3,916,674

This detection apparatus uses a rotating disk that is partially submerged in the body of water to be monitored. Liquids adhering to the surface of the disk are removed by a doctor blade and are accumulated in a settling vessel. Overflow is directed to an apparatus for detecting the presence of oil.

3,916,674
OIL-SPILL DETECTION SYSTEM
Gordon H. Miller, Richmond, and Edward O. Renick, Jr., Sandston, both of Va., assignors to Texaco Inc., New York, N.Y.
Filed Feb. 22, 1974, Ser. No. 444,934
Int. Cl.^{2} G01N *27/22*
U.S. Cl. 73–61.1 R **8 Claims**



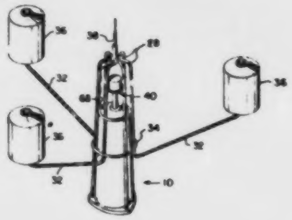
C-666-76
OIL SPILL DETECTION AND SIGNALING SYSTEM

Orth, O., Jr. 1975.
U.S. Patent 3,918,034

An oil-sensing assembly consists of a hydrophobic, oleophilic oil-sensing material secured to one end of a rod and a magnet secured to the opposite end of the rod. The rod extends into the central bore of a water-tight ballasted shell in which a battery-powered transmitter is located. The procedure for detecting and signaling the presence of an oil slick on a water surface is described.

Design and engineering

3,918,034
OIL DETECTION AND SIGNALING SYSTEM
George Otto Orth, Jr., Seattle, Wash., assignor to Petrotek, Inc., Bellevue, Wash.
Filed Feb. 11, 1974, Ser. No. 441,251
Int. Cl.^{2} G08B *21/00, 1/08*
U.S. Cl. 340—236 **12 Claims**



C-667-76
FIELD EVALUATION OF BENZOPYRENE HYDROXYLASE INDUCTION AS A MONITOR FOR MARINE PETROLEUM PRODUCTION

Payne, J. F. 1976.
Science 191 (4230):945-946.

Benzopyrene hydroxylase activity was measured in the fish, the cunner, from 4 different sites. Liver hydroxylase activity was significantly higher in fish from petroleum contaminated sites. Induction represents a sublethal response to petroleum pollution that can be easily monitored.

Biological effects of oil pollution

C-668-76
INSTALLATION TO DETECT AND SIGNAL OIL

Petrotek Inc. 1975.
Netherlands Application 7,501,537

The invention relates to a floating installation which detects oil on a water surface. The installation consists of a ballasted, watertight housing surrounding a vertically oriented central bore. Within the bore is a buoyant rod with an oil-sensitive device at the tip. When the device detects floating oil, it activates a signal.

Design and engineering

C-669-76
MONITORING REQUIREMENTS

Preston, A. 1975.
Petroleum and the Continental Shelf of North West Europe.
H. A. Cole (ed.). Barking, United Kingdom, Applied Science Publishers, 1975. Vol. 2. Environmental Protection. p. 115-120.

The role of monitoring the maintenance of environmental quality and control of marine pollution is discussed. Present monitoring requirements due to potential oil pollution in northwest European shelf waters are reviewed.

C-66-76
MARINE POLLUTION DATA ARCHIVING AND EXCHANGE

Morse, R. M. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop, National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.). NBS Special Publication No. 409. p. 41-44.

In 1971 the International Oceanographic Data Exchange established an ad hoc Group on Marine Pollution Data. This group was charged with identifying the types of data that should be included routinely in the data base for international exchange and recommending a means for evaluating already stored data. Two additional ad hoc groups (Format Development and on IGOSS Data Archiving and Exchange) are also interested in the problem.

C-670-76
DETERMINING THE CONCENTRATION OF SMALL AMOUNTS OF OIL IN WATER

Salen och Wicander AB. 1975.
British Patent 1,402,825

An apparatus for use on ships was employed to measure the concentrations of oil in water above ~1/100,000. A predetermined amount of liquid is passed over a predetermined area of filter material and the amount of oil absorbed in the filter is measured photometrically. The use of a dye impregnated in the filter is optional.

Design and engineering

C-71-76
SCIENTIFIC PROBLEMS OF THE SYSTEMS FOR GLOBAL MONITORING AND INVESTIGATION OF OIL POLLUTION IN THE WORLD OCEAN

Simonov, A. I. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop,
National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.).
NBS Special Publication No. 409. p. 9-14.

The background and global aspects of the problem, the role of hydrodynamic factors in the movement of pollutants, the dispersion and degradation of oil in the environment, and the main components of a global monitoring system for oil pollution are topics discussed. The parameters that must be measured and critical regions to be monitored are reviewed.

Physical changes of oil in the environment, General fate of oil in the environment

C-74-76
PILOT PROJECT ON MARINE POLLUTION MONITORING UNDER THE FRAMEWORK OF IGOSS

Tolkachev, A. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop,
National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.).
NBS Special Publication No. 409. p. 21-26.

The tasks of the pilot project are to determine the state of oil pollution in certain oceanic areas and to specify the areas and frequency of observations for a future oil monitoring system. Sampling and analytical procedures will be standardized. The hydrographic measurements necessary and the participants in the pilot project are discussed.

Sampling, Analysis

C-671-76
DEVELOPMENT OF AN OIL-WATER POLLUTION MONITORING SYSTEM

Tyler, B. H. 1975.
U.S. Naval Postgraduate School, Masters Thesis. 89 p.

In the prototype developed, a direct difference method of total organic carbon determination was used to determine oil concentrations. It was possible to specify the concentration of any oil in a known sample using this monitoring system.

Design and engineering

C-77-76
REGULATORY FUNCTIONS

Wastler, T. A. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop, National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.). NBS Special Publication No. 409. p. 57-60.

The kinds and availability of monitoring data needed for regulatory purposes and the types of developments desired are discussed. No oceanic monitoring program is yet effective enough to support a regulatory function. Techniques for automatically measuring tar balls and films and for source identification are desired.

International legislation, Source identification

C-78-76
UNITED NATIONS ENVIRONMENT PROGRAM EARTHWATCH AND MARINE POLLUTION

White, R. M. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop, National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.). NBS Special Publication No. 409. p. 3-8.

The attention given to marine pollution by various groups, including the UN Environment Program, is reviewed. All studies have agreed that petroleum is a pollutant that must be monitored. Funds from the UN program are available for international monitoring of ocean pollution.

C-672-76
MONITORING OF GROUND WATER QUALITY IN WEST VIRGINIA

Wilmoth, B. M. 1974.
West Virginia Academy of Sciences, Proceedings 46(1):94-99.

One of the first tasks of a monitoring program is to sample enough wells in each aquifer to characterize the existing water quality. Periodic resampling will then show any changes. Monitoring should be done in areas close to pollution sources (refined petroleum products, brines, chemicals, wastes) and where heavy pumping can create unnatural gradients that allow hydrocarbons to migrate into the aquifers.

Physical changes of oil in the environment

C-673-76
A NEW INFRARED INSTRUMENT FOR MONITORING OIL FILMS ON WATER

Wright, D. E., and J. A. Wright. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop, National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.). NBS Special Publication No. 409. p. 93-94.

This automatic remote detection device is based on the infrared reflectance properties of water surfaces. The instrument is able to detect oil 24 hours a day, in heavy rain, fog or high humidity, and is specific to petroleum oils.

Remote sensing, Design and engineering

C-82-76
OIL SPILLAGE MONITORING, SAMPLING AND RECOVERY SYSTEMS

Zahka, J. G. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop, National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.). NBS Special Publication No. 409. p. 89-90.

The author describes the basic technology of the oil spill monitoring, sampling and recovery systems developed by Durham Associates, Inc. These systems depend on the hydrophobic, lipophilic properties of certain materials.

Sampling, Cleanup and recovery

3. REMOTE SENSING

C-674-76
REMOTE SURVEILLANCE OF OIL- AND GAS-FIELD ACTIVITIES IN ALABAMA

Sapp, C. D., and K. E. Richter. 1975.
Alabama Geological Survey. Oil and Gas Report, No. 4. 26 p.

The task of regulating and monitoring oil and gas development activities is increasing as Alabama's coastal waters are being prospected for these resources. The introduction of remote-sensing techniques into the monitoring program of the Oil and Gas Board will greatly aid the Board's function in this area.

General effects of oil prospecting and production, Monitoring

C-675-76
FINGERPRINTING OIL SPILLS

Anon. 1975.
Marine Technology Society Journal 9(10):45.

A prototype Airborne Oil Surveillance System (AOSS), developed by Aerojet Electro Systems Company, is able to detect, map and document oil spills on the high seas in all types of weather, day or night. The Coast Guard will use this surveillance device and multisensor systems to increase its search and rescue and law enforcement capabilities.

Design and engineering

C-676-76
OIL POLLUTION MEASUREMENT BY LASER

Anon. 1975.
Bulletin of Institution of Engineers (India) 24:42.

The University of Bergen is developing a laser beam to measure oil pollution. Using the reflections produced, the type of oil and thickness of the layer will be detected. A mounted detector could be used near drilling platforms for monitoring purposes.

Monitoring

C-677-76
THE EARTH IN THE LOOKING GLASS

Darden, L. 1974.
Garden City, N.Y., Anchor Press/Doubleday, 1974. ix + 324 p.

The various capabilities of the Earth Resources Technology Satellites (ERTS) are described. ERTS imagery and other remote sensing data provide information in many areas, including identification and location of polluted areas and oil slicks.

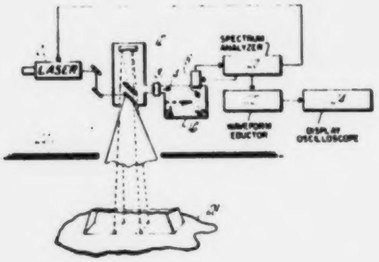
Monitoring

C-678-76
AIRBORNE LASER REMOTE SENSING SYSTEM FOR THE DETECTION AND IDENTIFICATION OF OIL SPILLS

Fantasia, J. F., and H. C. Ingrao. 1975.
U.S. Patent 3,899,213

A laser beam is used to direct laser energy onto the spill to cause the oil to fluoresce. The frequency spectrum of the generated fluorescence is incremently scanned. Injection of background radiation and real time presentation of the fluorescence spectrum of the spilled oil are also included in the method.

3,899,213
AIRBORNE LASER REMOTE SENSING SYSTEM FOR THE DETECTION AND IDENTIFICATION OF OIL SPILLS
John F. Fantasia, Newton, and Hector C. Ingrao, Wellesley, both of Mass., assignors to The United States of America as represented by the Secretary of the Department of Transportation, Washington, D.C.
Filed Mar. 8, 1974, Ser. No. 449,327
Int. Cl.^{2} G01T *1/169*; G01N *21/38*
U.S. Cl. 250—301 **8 Claims**



C-679-76
STUDY OF THE THERMAL RADIOWAVELENGTH EMISSION OF THE WATER SURFACE COVERED WITH OIL FILM

Glotov, A. A., D. T. Matveyev, V. G. Mirovskiy, M. D. Rayev,
V. Yu. Rayser, I. A. Troitskiy, Ye. A. Sharkov, and V. S. Etkin.
1975.
Meteorology and Hydrology (6):115-119. [JPRS-65607]

A sensitive 2-cm band radiometer was used to measure the radio brightness temperature of a smooth wavy surface covered by a solar oil and kerosene film. The film thickness and the dielectric parameters of solar oil and kerosene can be determined by comparing the experimental and calculated values of the thermal radiowave length emission.

C-680-76
THE FEASIBILITY OF OIL-POLLUTION DETECTION AND MONITORING FROM SPACE: EXAMPLES USING ERTS-1 AND SKYLAB DATA

Goldman, G. C., and R. Horvath. 1975.
Final report, USCG-D-117-75, Contract DOT-CG-24063-A. 59 p.
[AD-A017 098/5GA]

The capabilities of ERTS-1 and SKYLAB for oil pollution detection, monitoring and enforcement were demonstrated. Various digital-computer and photointerpretation methods were used in an attempt to evaluate the best way to analyze the data for pollution detection purposes.

Monitoring

C-681-76
LASER INDUCED LUMINESCENCE SIGNATURES OF REFINED AND VIRGIN CRUDE PETROLEUM, THEIR COMPOSITION AND REMOTE SENSING IMPLICATIONS

Gross, H., and M. Muramoto. 1974.
Conference on Earth Resources Obs. and Inf. Anal. Systems: Remote Sensing of Earth Resources, Tullahoma, Tennessee, 1974. Tullahoma, University of Tennessee Space Institute, 1974. Vol. 3:783-803.

The structural luminescence spectra of 10 virgin crude oils and one refined fuel oil were produced. The as-measured spectra have one principal peak; spectrally corrected spectra have two or more peaks. The implications of signatures in the visible are discussed.

Analysis

C-682-76
LOS ANGELES HARBOR FIELD INVESTIGATION OF OIL AND BACKGROUND LUMINESCENCE SIGNATURES

Gross, H. G. 1975.
Final report, USCG-D-154-75, Contract DOT-CG-51998-A. 121 p.
[AD A016 466/5GA]

UV laser induced luminescence signatures were determined for 5 sites in Los Angeles Harbor and one inland water source. An analysis of the similar signatures suggests that oil and grease are the principal pollutants. Reflectance signatures and their relationship to composition need more study. One component of the signature of oil films is due to sky scattered daylight and direct sun UV radiation.

Analysis

C-683-76
APPLICATION OF LUMINESCENCE METHODS FOR DETERMINATION OF AROMATICS IN WATER

Hornig, A. W., and J. T. Brownrigg. 1975.
International Seminar and Exposition on Water Resources Instrumentation, Chicago, Illinois, 1974. R. J. Krizek, and E. F. Mosonyi (eds.). Ann Arbor, Michigan, Ann Arbor Science Publishers, 1975. Vol. 1. Measuring and Sensing Methods. p. 141-168.

Less than a nanogram of aromatics can be detected without preconcentration. The specificity of the excitation and fluorescence spectra, particularly at low temperatures, allows analysis without prior physical separation. Examples of instrumentation, such as airborne remote sensors and elaborate laboratory setups, and data on algae, oil, pesticides, etc., are presented.

Analysis

C-684-76
REMOTE SENSING OF WATER POLLUTANTS

Klemas, V. [publication data unknown]
Joint Conference on Sensing of Environmental Pollutants, 2nd, Washington, D.C., 1973. p. 337-371.

Methods of detecting and measuring pollutants in water resources are discussed in five papers. Results of ERTS-1 studies, which predict oil slick movement and estimate sediment transport, are being used to verify hydrodynamic models. Airborne television systems being developed to evaluate techniques for oil spill surveillance include the conventional TV camera, two cameras operating in a subtractive mode, and a field-sequential camera.

General fate of oil in the environment, Monitoring

C-685-76
REMOTE SENSING OF OCEANS USING MICROWAVE SENSORS

Krishen, K. [1974?]
Remote Sensing Applied to Energy-Related Problems. T. N. Veziroglu (ed.). Coral Gables, Fla., University of Miami, [1974?]. p. S2-25, S2-27.

Active and passive microwave sensors can be used to detect ocean surface waves, temperature, salinity, storm cells and oil slicks. The strong correlation between ocean surface winds and waves, storm regions, and oil slicks is demonstrated with radar backscattering cross section data. Microwave sensors are suitable for gathering data under a wide variety of conditions.

C-686-76
A REMOTE SENSING LASER FLUOROMETER

O'Neil, R. A., A. R. Davis, H. G. Gross, and J. Kruus. 1974.
Laser and Unconventional Optics Journal (52):3-44.

An airborne fluorosensor has been developed by the Department of the Environment (Canada) to detect oil spills, chlorophyll, dye and other industrial chemical wastes. The system has wide applications in monitoring naturally occurring waters for pollutants.

Monitoring

C-687-76
A PRACTICAL OIL SENSOR

Rambie, G. S. 1974.
International Symposium on Remote Sensing of Environment, 9th, Environmental Research Institute of Michigan, 1974. Vol. 3:1685-1694.

This report describes and discusses the advantages of a two-wavelength, active monostatic infrared sensor capable of detecting anomalous dispersion which occurs in petroleum products near 3.4 micrometers. This method yields a signature which is proportional to reflectivity only and is independent of common mode effects.

C-688-76
MAPPING AND IDENTIFICATION OF OIL ON WATER BY THE USE OF AN AIRBORNE LASER SYSTEM

Schwemmer, G. K., and H. H. Kim. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop, National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.). NBS Special Publication No. 409. p. 95-96.

NASA Wallops Flight Center is investigating the use of a 500 parallel optical multichannel analyzer (OMA) for a laser oil fluorosensing technique. OMA has been tested and can be used to detect oil spills as small as 2.7 m diameter from an aircraft traveling at 300 km/hr. Further improvements are visualized.

Monitoring

C-689-76
REMOTE SENSING OF OIL SPILLS

Thomson, K. P. B., S. Ross, and H. E. Howard-Lock. 1975.
Canadian Society of Petroleum Geologists Memoirs, No. 4. p. 829-840.

The state-of-the-art in the remote detection of oil spills, specifically in terms of Canadian experience and needs is discussed. The advantages and disadvantages of the following basic types of sensor packages are presented: passive imagery techniques operating in the visible range of the spectrum, microwave systems, and active or specialized techniques.

C-690-76
OPTIMIZATION AND EVALUATION OF A FLUORESCENCE OIL SPILL DETECTOR. VOLUME I. LABORATORY MEASUREMENTS AND FIELD EVALUATION

Webb, W. A., and H. G. Eldering. 1975.
Final report, No. 5/75-6233-Vol-1 USCG-D-108-75, Contract DOT-CG-43845-A. 108 p. [AD-A016 460/8GA]

The objective of this research was to maximize the detection range of an automatic fluorescence oil spill detector and to evaluate its capabilities. The fluorescence spectral distributions and intensities of 22 oils were compared. On the basis of measurements in 2 spectral regions, oil fluorescence can be consistently discriminated from marine fluorescence.

Design and engineering

C-691-76
THE USE OF TELEVISION FOR REMOTE SENSING

Worsford, R. D., J. A. Allen, and B. E. Fretts. 1975.
Remote Sensing of the Environment 4(1):5-35.

The use of television for the remote sensing program of the Canada Center for Remote Sensing is described. Test programs at this center have indicated that television is a very useful sensor system for navigation, flight path recovery for postflight comparison and training, and oil spill monitoring.

Monitoring

C-692-76
DESIGNING WATER POLLUTION DETECTION SYSTEMS

Wright, G. P., and D. G. Alson. 1974.
Cambridge, Mass., Bollinger Publishing Company, 1974. 217 p.

The major topic discussed is an air surveillance system used by the Coast Guard in detecting and tracking oil spills. Also included are a statistical analysis of 1968-1972 pollution incidents in the U.S., a description of the National Oil and Hazardous Substances Pollution Contingency Plan, and the role of the Coast Guard in pollution detection.

Reporting, Contingency planning

4. SAMPLING

C-18-76

SAMPLING ERRORS IN THE QUANTIFICATION OF PETROLEUM IN BOSTON HARBOUR WATER

Ahmed, A. M., M. D. Beasley, A. C. Efromson, and A. C. Hites. 1974.
Marine Pollution Monitoring (Pollution) Symposium and Workshop,
National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.).
NBS Special Publication No. 409. p. 109-112.

The precision and accuracy of the infrared spectrophotometric method of analyzing for oil-in-water was studied using 2 techniques of oil preconcentration (carbon tetrachloride extraction and polyurethane foam adsorption). The liquid-liquid extraction is much more efficient than the foam. Replication improves the precision better than increasing the sample size.

Monitoring, Analysis

C-29-76

SAMPLING MARINE ORGANISMS AND SEDIMENTS FOR HIGH PRECISION GAS CHROMATOGRAPHIC ANALYSIS OF AROMATIC HYDROCARBONS

Bruce, H. E., and S. P. Cram. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop,
National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.).
NBS Special Publication No. 409. p. 181-182.

Sampling techniques used to collect sediment and intertidal organisms from Prince William Sound for hydrocarbon analysis are described. Precautions taken to minimize contamination and sample handling errors and the design necessary to obtain statistically representative and reproducible samples are described.

Analysis

C-32-76

EVALUATION OF THIN FILM OIL SAMPLERS

Chang, W. J., and J. R. Jadamec. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop,
National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.).
NBS Special Publication No. 409. p. 85-88.

Four prototype, boat-deployable, thin-film oil samplers were evaluated by the Coast Guard. All used oleophilic sorbents and two used a surfactant as well. The samplers are described and efficiency and ability to maintain the chemical integrity of the oil discussed. The sorbents contained extractables that interfered with analysis. Recommendations for improvement are made.

Design and engineering

C-43-76

HYDROCARBON CONCENTRATIONS IN SEAWATER ALONG THE HALIFAX-BERMUDA SECTION: LESSONS REGARDING SAMPLING AND SOME RESULTS

Gordon, D. C., Jr., and P. D. Keizer. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop, National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.). NBS Special Publication No. 409. p. 113-115.

Surface samples are collected with "slurp bottles," deeper samples are collected with glass bottles or Knudsen bottles. All samplers must be rinsed with solvent after each use to recover any adsorbed material. The entire contents of the sampler must be extracted which restricts size to 1-5 l. Analytical techniques and results from sampling the Halifax-Bermuda section in April, 1974, are reported.

Reporting, Analysis

C-50-76

PELAGIC TAR IN THE GULF OF MEXICO AND CARIBBEAN SEA

Jeffrey, L. M., W. E. Pequegnat, E. A. Kennedy, A. Vos, and B. M. James. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop, National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.). NBS Special Publication No. 409. p. 233-236.

Floating tar was sampled with both plankton and neuston nets, transferred to glass jars and frozen. On shore the samples were weighed. The Gulf of Mexico has more tar than the Caribbean and about the same amount as the Gulf Stream. The source of most of the pelagic tar is shipping and tanker cleaning operations.

Reporting, Source identification

C-693-76

HYDROCARBONS IN WATER AND SEDIMENT SAMPLES FROM COAL OIL POINT AREA, OFFSHORE CALIFORNIA

Koons, C. B., and D. E. Brandon. 1975.
Offshore Technology Conference, 7th, Houston, Texas, 1975. Vol. 3, Paper OTC 2387:513-521.

Water samples were collected from within a one-square nautical mile area of the Coal Oil Point submarine seeps and from 10-15 miles to the ESE in the offshore Point Dume area. Coal Oil Point samples had higher concentrations of dissolved hydrocarbons, particularly for the heavy (C_{15-30}) fraction. The concentrations ranged from 0.2 to 16 ppb, agreeing with Atlantic and Gulf of Mexico findings.

C-694-76
A COMPARISON OF TWO SAMPLING DEVICES FOR THE RECOVERY OF ORGANICS FROM AQUEOUS SURFACE FILMS

Ledet, E. J., and J. L. Laseter. 1974.
Analytical Letters 7(8/9):553-562.

The consistency and efficiency of teflon disc and wire screen type surface film samplers in retrieving hydrocarbons, aromatics and fatty acids were determined. Results suggest that each device exhibits selectivity in its ability to recover organic compounds at the air-water interface.

Cleanup and recovery

C-60-76
TAR BALL SAMPLING IN THE WESTERN NORTH ATLANTIC

McGowan, W. E., W. A. Sauer, and G. L. Hufford. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop, National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.). NBS Special Publication No. 409. p. 83-84.

A neuston net was used to sample floating tar balls concentration at four ocean stations for three years. The concentration is highly variable, but concentrations tend to increase from north to south. The southernmost station is at the center of a subtropic anti-cyclonic gyre that moves surface water and tar toward the center.

Reporting, General fate of oil in the environment

C-69-76
TAR BALL LOADINGS ON GOLDEN BEACH, FLORIDA

Sauer, W. A. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop, National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.). NBS Special Publication No. 409. p. 79-82.

Beach tar was sampled from various sections of a sandy beach for one year in order to evaluate the effects of size of sampling zone, time and wind on tar deposition. A strong correlation exists between heavy oil deposition and northeast winds.

Reporting, General fate of oil in the environment

C-695-76
ESTIMATION OF THE MODERN OIL POLLUTION OF THE NORTH ATLANTIC WATERS

Simonov, A. I., S. G. Oradovski, and A. A. Justchak. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop,
National Bureau of Standards, Maryland, 1974. J. C. Junghans (ed.).
NBS Special Publication No. 409. p. 245.

The spatial and vertical distribution of oil products in the North Atlantic was determined by the USSR Hydrometeorological Service. Minimum and maximum concentrations are controlled by the dynamics of the ocean. The vertical distribution is highly variable due to the different specific gravities of different fractions.

Physical changes of oil in the environment

C-696-76
REPORT ON THE SAMPLING OF REFINERY LIQUID EFFLUENTS

Stichting CONCAWE. 1975.
The Hague, Netherlands, Stichting CONCAWE, 1975. Report 3/75.

The report concentrates on the industry's need to accurately determine the major sources of contaminants, to select the proper type and size of effluent treatment facilities, and to control pollution. The methods discussed include homogenization for increased accuracy in analysis, automatic proportional sampling and effluent flow measurement methods.

Waste treatment and disposal methods

C-73-76
FIELD SAMPLING METHODS AND TECHNIQUES FOR MARINE ORGANISMS AND SEDIMENTS

Straughan, D. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop,
National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.).
NBS Special Publication No. 409. p. 183-188.

The problems of gathering representative data to describe levels of petroleum content of sediments and organisms in an area are discussed. Location of samples, sample size, the number of samples, timing and/or frequency of sampling, and containers and preservation methods are all considered.

Monitoring

C-81-76

THE ROLE OF STANDARD REFERENCE MATERIALS IN ENVIRONMENTAL MONITORING

Yolken, H. T. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop,
National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.).
NBS Special Publication No. 409. p. 157-160.

NBS-SRMs (Standard Reference Materials) are designed to help ensure meaningful measurement. They are certified and of known accuracy. Currently available and planned NBS-SRMs are described; the possibility of NBS producing trace crude oil constituent SRMs is discussed.

Analysis

C-84-76

HYDROCARBON CONTENT AND CHLOROPHYLL CORRELATION IN THE WATERS BETWEEN NOVA SCOTIA AND THE GULF STREAM

Zsolnay, A. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop,
National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.).
NBS Special Publication No. 409. p. 255-256.

Samples were taken on a cruise that went due south from Nova Scotia to the Gulf Stream. Hydrocarbon and chlorophyll concentrations were determined. The equation relating the hydrocarbon and chlorophyll concentrations indicates that anthropogenic hydrocarbon material (probably of pollutant origin) is present in the ocean to the south of Canada but absent off Northwest Africa, as determined in an earlier cruise.

Reporting , Source Identification

5. ANALYSIS

C-697-76
DOMINANT CHEMICAL COMPOSITION OF SEA-SURFACE FILMS, NATURAL SLICKS, AND FOAMS

Baier, R. E., D. W. Goupil, S. Perlmutter, and R. King. 1974.
Journal de Recherches Atmospheriques 8(3-4):571-600.

Techniques with the capability of sensing monomolecular layers were used to determine petroleum, lipids, proteins, and polysaccharides in films on ocean waters. Natural sea slicks are dominated by glycoproteins and proteoglycans; pollutant slicks are dominated by aliphatic hydrocarbons and highly esterified oils.

Reporting

C-698-76
A CONTINUOUS FLOW BIOASSAY METHOD TO EVALUATE THE EFFECTS OF OUTBOARD MOTOR EXHAUSTS AND SELECTED AROMATIC TOXICANTS ON FISH

Brenniman, G., P. Hartung, and W. J. Weber, Jr. 1976.
Water Research 10(2):165-169.

Continuous flow bioassays were run for 24, 48, 72, 96 and 720 hours to determine lethal concentrations for 50% of the goldfish (Carassius auratus) of leaded outboard motor exhaust (OME), non-leaded OME, toluene, xylene, and 1,3,5 trimethylbenzene. The LC-50 determinations revealed that goldfish can withstand relatively high levels of these compounds. The continuous flow method is a more reliable indicator of the effects of OME pollution on aquatic organisms than is the static bioassay method.

Biological effects of oil pollution

C-699-76
FOSSIL FUEL ANALYSIS BY LIQUID CHROMATOGRAPHY

Dark, W. A. 1975.
American Laboratory 7(8):50-52, 54-55.

The analysis or identification of crude oil, refined oils and asphalt by gel permeation and liquid chromatography is reviewed.

Source identification

C-700-76

HYDROCARBONS IN BLUE MUSSELS FROM THE KIEL BIGHT

Ehrhardt, M., and J. Heinemann. 1975.
Environmental Pollution 9(4):263-282.

Blue mussels (Mytilus edulis) have been analyzed for recent biogenic and petroleum-derived hydrocarbons. Column chromatography and IR- and UV-spectroscopy were used to separate and monitor the composition of hydrocarbon fractions. The composition of hydrocarbons extracted from the mussels depended upon the time of sampling.

Biological effects of oil pollution

C-40-76

ANALYSIS OF HYDROCARBONS IN MARINE ORGANISMS: RESULTS OF IDOE INTERCALIBRATION EXERCISES

Farrington, J. W., J. M. Teal, J. G. Quinn, P. L. Parker,
J. K. Winters, T. L. Wade, and K. Burns. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop,
National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.).
NBS Special Publication No. 409. p. 163-166.

Four laboratories analyzed a tuna meal sample from NBS using the techniques and methods employed at that time in the respective laboratories. The methods are outlined, and the results compared. Agreement was fair, but discrepancies are not always from the same laboratory. Inter-calibration is needed, even when the same methods of analysis are used.

C-42-76

ANALYSIS STANDARDS AND INTERCOMPARISON OF DATA

Galler, S. R. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop,
National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.).
NBS Special Publication No. 409. p. 29-30.

The National Bureau of Standards has expertise on basic standards of measurement, which is of use to the National Oceanographic Instrumentation Center in dealing with real world measurement problems. NBS is also able to critically review an existing body of data and give reliability evaluations.

Monitoring

C-701-76
HYDROCARBONS IN SPRING WATERS - OIL POLLUTION OR NATURAL SUBSTANCES?

Hellmann, H., and M. Holoczek. 1974.
Tenside Detergents 11(4):197-201. (Translated from German, Fisheries and Marine Service, Translation Series No. 3477, 1975)

Infrared-spectroscopic and gas-chromatographic techniques were used to determine typical hydrocarbon levels in springs, and the spectral composition of biogenic hydrocarbons as compared to mineral-oil components. The spectral distribution of the normal-paraffins and aromatics shows mineral-oil pollution to be minor.

Source identification

C-44-76
METHODS FOR TRACE ORGANIC ANALYSIS IN SEDIMENTS AND MARINE ORGANISMS

Hertz, H. S., S. N. Chesler, W. E. May, B. H. Gump, D. P. Enagonio, and S. P. Crain. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop, National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.). NBS Special Publication No. 409. p. 197-200.

Since tanker traffic and increased oil activity are likely to increase hydrocarbon levels in Port Valdez, a baseline study of aromatic hydrocarbons (ppb) is being conducted. Techniques for isolating and measuring trace organics have been developed for both sediment and marine organisms. These techniques are described in detail.

C-702-76
ANALYSIS OF TRACE QUANTITIES OF OIL IN WATER BY GAS CHROMATOGRAPHY

Langdon, W. M., T. Mark, and D. T. Wasan. 1975.
International Seminar and Exposition on Water Resources Instrumentation, Chicago, Illinois, 1974. R. J. Krizek, and E. F. Mosonyi (eds.). Vol. 1. Measuring and Sensing Methods. p. 202-214.

A method which involves extraction with benzene followed by gas chromatographic analysis can be used to detect kerosene in water at the ppm level. The average deviation was 0.6 ppm for the 1-15 ppm range. The column is temperature programmed to start at 40°C for benzene, and then to increase at 34°C/min to 235°C for kerosene.

C-703-76
AQUEOUS SOLUBILITIES OF WEATHERED NORTHERN CRUDE OILS

Mackay, D., and W. Y. Shiu. 1976.
Bulletin of Environmental Contamination and Toxicology 15(1):101-109.

The application of a gas stripping method to the determination of the aqueous solubility of weathered crude oils is described and some environmental implications are discussed. It is suggested that this is the best method for determining the aqueous solubility of the lighter components of crude oils.

General fate of oil in the environment

C-704-76
MERCURY IN CRUDE OIL RESIDUES

May, L. A. 1975.
Chemosphere 4(6):329-332.

The concentrations of total mercury in 29 crude oil residues were determined by instrumental neutron activation analysis. Not only is the mercury-hydrocarbon association evidence that mercury may be concentrated and transported by hydrocarbons, but also it is an indication of a possible cause of crude oil toxicity.

Biological effects of oil pollution

C-63-76
IDOE-5 INTERCALIBRATION SAMPLE: RESULTS OF ANALYSIS AFTER SIXTEEN MONTHS STORAGE

Medeiros, G. C., and J. W. Farrington. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop, National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.). NBS Special Publication No. 409. p. 167-170.

The stability of a petroleum-spiked cod liver lipid extract was tested by analyzing 2 subsamples after 16 months. The analyses from the 2 time periods are in agreement. The wet chemical and instrumental analyses can be done quite adequately by trained laboratory assistants under supervision.

C-705-76
QUALITATIVE DEMONSTRATION AND QUANTITATIVE DETERMINATION OF PETROLEUM AND PETROL (GASOLINE) OF NORMAL, SPECIAL AND SUPER GRADES IN WATER BY MEANS OF FLUORESCENCE SPECTROPHOTOMETRY [English summary]

Minarik, Z. 1974.
Ceskoslovenská Hygiena 19/8:382-385.

Fluorescent spectrophotometry can be used to analyze petroleum and gasoline in water. A xenon discharge lamp was used as the exciting light (290 nm). Cations and anions in the water alter the fluorescence; the modification is related to the concentration of both the petroleum and the ions.

C-706-76
ORGANICS

Minear, R. A., and P. S. Pagoria. 1974.
Journal Water Pollution Control Federation 46(6):1058-1100.

The nature and analysis of organics, including oils and grease, are reviewed. The literature reviewed includes papers on levels of oil pollution, oil uptake, biodegradation, analytical techniques for oil, remote sensing, weathering and interference of oil films with gas transfer.

Bibliographies, Reporting, General fate of oil in the environment, Biological effects of oil pollution

C-707-76
THE DETERMINATION OF HYDRAULIC OIL IN THE CONCAST PLANT COOLING WATER USING I.R. SPECTROSCOPY

Nicholson, M., and J. Taylor. 1975.
Great Britain, GS/EX/35/741C. 10 p. [PB-245 060/9GA]

Hydraulic oil in the cooling water samples from South Teeside Works can be detected using an infrared technique. Soluble and total oil contents are determined. Results are compared with those found using a solvent extraction-gravimetric technique.

Monitoring

C-708-76
DETERMINATION OF HYDROCARBONS IN WATER [English summary]

Ranchet, J., and P. Clement. 1975.
Lab Cent Ponts Chaussees Bull Liaison Lab Ponts Chaussees (79):68-72.

Three methods of determining hydrocarbons in water by infrared spectrography were studied and compared. The boundary threshold of hydrocarbon detection in water in the absence of interfering elements was found to be 0.1 mg/l.

C-709-76
BIOGENIC AND NON-BIOGENIC ORGANIC POLLUTANTS [English summary]

Schmitz, W., and W. Kölle. 1975.
Schweizerische Zeitschrift fuer Hydrologie 37(1):85-98.

Refractory organic compounds in the Rhine have been analyzed and reported; among them are 18 hydrocarbons and 9 phenols. The methods are tedious. A technique for determining the ratio of persistent to biodegradable organic compounds would be useful. Microbial assays and surveys of waste discharges are discussed.

Reporting

C-70-76
DISTRIBUTION OF TAR BALLS AND NEUSTON SAMPLING IN THE GULF STREAM SYSTEM

Sherman, K., J. B. Colton, R. L. Dryfoos, K. D. Knapp, and
B. S. Kinnear. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop,
National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.).
NBS Special Publication No. 409. p. 243-244.

Neuston net samples made for fish eggs and larvae were also analyzed for tar balls. The amount retained was minimal but indicates that tar balls are a widespread phenomenon. Heavy concentrations were found in the Sargasso Sea. The composition of these tar balls indicates tanker wastes as the source of pollution.

Source identification

C-710-76
DETERMINATION OF POLYCYCLIC AROMATIC HYDROCARBONS IN FOOD.
IV. 3,4-BENZOPYRENE IN FISH AND SHELLFISH

Shiraishi, Y., T. Shirotori, and E. Takabatake. 1975.
Shokuhin Eiseigaku Zasshi 16(3):178-181.

A new cleanup step which involves chromatography on a silica gel column with petroleum ether:ether (9:1) was added to the usual fluorospectrometric determination of 3,4-benzopyrene in fish and shellfish. Compound recovery was 91.0%. Using this method 11 of 19 samples of commercial fish and shellfish showed no 3,4-benzopyrene, and the rest showed only 0.08-9.85 ppb contaminant.

Biological effects of oil pollution

C-711-76
NATURE AND ANALYSIS OF CHEMICAL SPECIES: ORGANICS

Suffet, I. H., S. Friant, C. Marcinkiewicz, M. J. McGuire, and
D. T.-L. Wong. 1975.
Journal Water Pollution Control Federation 47(6):1169-1241.

This literature review of the nature and analysis of organic pollutants covers the analysis, effects, and toxicities of detergents and surfactants, oil and grease, and pesticides and related chlorinated hydrocarbon compounds. Organic analysis of various compounds such as plasticizers, humic acids, etc., is also reviewed.

Biological effects of oil pollution, Bibliographies

C-712-76
APPARATUS AND METHOD FOR TOTAL ANALYSIS OF HYDROCARBON SAMPLES

Szakasits, J. J., and A. E. Krc. 1975.
U.S. Patent 3,880,587

An apparatus that analyzes crude oil by programmed-temperature gas chromatography is described. The column is heated at 4°/min to 300°, the effluent is oxidized and analyzed for C and S content, the column is back-flushed and the injection port heated to 700° in the presence of O, and the recovered residue is analyzed for C and S. From these analyses the extent of weathering can be determined.

General fate of oil in the environment

C-713-76
ELECTROLYTIC STRIPPING CELL

Wasik, S. P. 1974.
U.S. Patent Application 525.430

This cell analyzes for dissolved hydrocarbons in seawater. Hydrogen gas bubbles are electrically generated. They strip the hydrocarbons from the seawater and rise to the head space. Gas chromatography is used to measure the hydrocarbon concentration in the head space.

C-714-76

DETERMINATION OF AROMATIC HYDROCARBONS IN SEA WATER USING AN ELECTROLYTIC STRIPPING CELL

Wasik, S. P., and R. N. Boyd. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop, National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.). NBS Special Publication No. 409. p. 117-118.

Hydrocarbons are stripped from seawater by small bubbles of electrolytically generated hydrogen gas. The hydrocarbon concentration is determined from the volume of the seawater and the hydrocarbon concentration in the headspace after a measured volume of hydrogen has bubbled through the stripping cell.

C-715-76

AROMATIC HYDROCARBONS IN AQUATIC FAUNA

Zitko, V. 1975.
Bulletin of Environmental Contamination and Toxicology 14(5):621-631.

A rapid analytical method for determining the presence of polynuclear aromatic hydrocarbons (PHC) in aquatic fauna is described. The detection limits of crude, Bunker C, and creosote oil for this method are 100, 50, and 100 μg/g lipid. PHC were not detected in fish or seals from Passamaquoddy Bay, New Brunswick, but were detected at concentrations ranging from 202 to 3254 μg/g lipid in shellfish.

Biological effects of oil pollution

6. SOURCE IDENTIFICATION

C-716-76
ABSTRACTS OF THE 1974 PITTSBURGH CONFERENCE ON ANALYTICAL CHEMISTRY AND APPLIED SPECTROSCOPY

Anon. 1974.
Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, Pittsburgh, Pa. [1974?]

The subjects of the papers include forensic and toxicological analysis, laboratory automation, new laboratory instrumentation, fingerprinting of oil spills, remote sensing of pollutants and the monitoring of water pollutants.

Remote sensing, Monitoring

C-717-76
ECONOTES - OIL FOIL (news brief)

Anon. 1975.
Environmental Action 7(14):11.

An oil discharge in July off Key West involved 50,000 gallons of oil and cost $347,430 to clean up. A Coast Guard investigation matched samples of the spilled oil with "fingerprints" from 50 ships, and found the captain of the Liberian tanker "Garbis" guilty of the discharge. Under U.S. law, the owners must pay the cleanup costs.

Economic effects of oil pollution

C-718-76
OIL FINGERPRINTING

Anon. 1976.
Science Digest 79(2):13-15.

The article briefly outlines the use of fluorescence spectroscopy, infrared spectroscopy, and gas chromatography in the identification of oil spill sources. These methods are currently used by the U.S. Coast Guard Research and Development Center in Groton, Connecticut.

Analysis

C-719-76
SAMPLING OF OIL SPILLS AND FINGERPRINTING BY INFRARED SPECTROSCOPY

Brown, C. W., M. Ahmadjian, and P. Lynch. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop,
National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.).
NBS Special Publication No. 409. p. 91-92.

Infrared spectra of crude oils in the 650 to 1200 cm^{-1} region provide unique fingerprints which can be used to identify the source of oil slicks. This method has been tested on several oil slicks in the past, and is being used on all types of petroleum weathered in floating containers on Narragansett Bay, on the roof of the laboratory and on seawater in the laboratory.

Analysis

C-720-76
INFRARED ANALYSIS OF WEATHERED PETROLEUM USING VACUUM TECHNIQUES

Brown, C. W., and P. F. Lynch. 1976.
Analytical Chemistry 48(1):191-195.

Natural weathering of oils exposed to the marine environment for 2-7 days was simulated by treating unweathered oils with warm salt water and then evacuating the dried sample. This method provides information on initial changes due to weathering, and provides a fast, accurate way of matching spill and source fingerprints.

General fate of oil in the environment

C-721-76
SOURCE IDENTIFICATION OF OIL SPILLS BY PATTERN RECOGNITION
ANALYSIS OF NATURAL ELEMENTAL COMPOSITION

Deuwer, D. L., et al. 1975.
NTIS, AD/A-006 471. 42 p.

The advantages of pattern recognition techniques and the values of various elements in this procedure are assessed. Procedures that compare field samples to single known source samples and to multiple artificially weathered source samples are evaluated.

Analysis

C-722-76
IDENTIFICATION OF WEATHERED OIL FILMS FOUND IN THE MARINE ENVIRONMENT

Frankenfeld, J. W., and W. Schulz. 1974.
Report, GRUS.2PA.74 USCG-D-107-75, CGR/DC-36/74, Contract
DOT-CG-23035-A. 206 p. [AD-A015 883/2GA]

Fifty-seven petroleum products were weathered, sampled, and examined by a variety of techniques. Four types of analyses were particularly useful in classifying petroleum types and identifying the source of the oil. They were thin-layer chromatography, infrared fingerprinting, gas chromatographic fingerprinting and liquid-liquid chromatography. Applications of these techniques are detailed.

Analysis

C-51-76
RECENT DEVELOPMENTS IN THE IDENTIFICATION OF ASPHALTS AND OTHER PETROLEUM PRODUCTS

Kawahara, F. K. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop,
National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.).
NBS Special Publication No. 409. p. 145-148.

Gas chromatography-electron capture (EC) detection has been successfully applied to the analysis of minor components present in asphalts. The weak acids are first converted to their respective pentafluorobenzyl derivatives. This method has been used to provide legal evidence of the source of asphalt pollution.

Analysis

C-723-76
IDENTIFICATION OF OIL SPILL IN THE NATURAL ENVIRONMENT

Kortsch, W. E. 1975.
Chemistry in Canada 27(11):21.

The following analytical methods were tested for their suitability in identifying the source of oil spills in the natural environment: fluorescence spectroscopy, ultraviolet spectroscopy, infrared spectroscopy, nuclear magnetic resonance spectroscopy, atomic absorption, and computerized gas chromatography/mass spectrometry. The last method was the most suitable of all methods tested.

Analysis

C-724-76
AIRCRAFT AGAINST SEA POLLUTION [English summary]

Lerendu, Y. 1975.
L'Aeronautique et l'Astronautique (52):37-47.

Aircraft identification of oil spill sources on the basis of analyses of the physical and chemical characteristics of the supernatant hydrocarbon layers is described. Methods of analyzing the infrared, visible, and Hertzian radiation of polluted and non-polluted seas are discussed.

Analysis, Remote sensing

C-725-76
DETERMINATION OF TRACE ELEMENTS IN BEACH ASPHALTS BY NEUTRON ACTIVATION ANALYSIS

May, L. A., and B. J. Presley. 1975.
Journal of Radioanalytical Chemistry 27(2):439-445.

The concentrations of Br, Co, Cr, Sc, Zn and V were determined for 30 crude oil residues collected from beach asphalt using neutron activation analysis. The feasibility of using trace multielement data obtained from this analytical technique to identify the source of crude oil residues is demonstrated.

Analysis

C-726-76
THE ECOLOGICAL, CHEMICAL AND HISTOPATHOLOGICAL EVALUATION OF AN OIL SPILL SITE. PART II. CHEMICAL STUDIES

Mayo, D. W., C. G. Cogger, and D. J. Donovan. 1975.
Marine Pollution Bulletin 6(11):166-170.

The spill in Long Cove, Searsport, Maine, was identified as No. 2 fuel oil mixed with JP5 jet fuel. Gas chromatographic techniques were used to analyze sediment samples. The studies indicated a lingering impact, partly due to the leaching of oil from saturated sediments at higher elevations.

Analysis, Physical changes of oil in the environment

C-727-76
SURVEY OF ORIGIN OF TAR BALLS ON THE ISRAELI COAST

Shekel, Y., and R. Ravid. 1975.
Scientific Conference of the Israel Ecological Society, 6th, Tel Aviv, 1975. p. 379-380.

The question of whether tar balls off the Israeli coast originate from North African or Middle Eastern sources was investigated. Gas chromatographic "fingerprints" and sulfur, vanadium and nickel contents were used to match tar ball samples, original crudes and oil residue samples from vessels. Middle Eastern crudes and fuel oil used in ships were the primary sources.

Analysis

B. OIL POLLUTION PREVENTION AND CONTROL

1. CONTAINMENT

C-728-76
MARINE FLOATING SCREEN

Anon. 1975.
Waste and Water Treatment 18(2):24.

The floating screen called 'Seaboom' is used to contain oil spilt through transport and transhipment, oilwell drilling and waste disposal of refineries and industries. The screen consists of thick vinyl plate elements and floats on a tube, standing upright in the water and extending .3 meters above the surface.

Design and engineering

C-729-76
MECHANIZED BOOM RECOVERY SYSTEM DESIGNED BY MARCO ENGINEERS

Anon. 1975.
Sea Technology 16(11):36.

The Marine Construction and Design Co. (Marco) has designed an inflatable, floating Vikoma "Seaboom" to contain oil spills. The "Seaboom" can be recovered quickly (~490 meters in 8 minutes) and is operable by 3 men--one to operate the hydraulics and two to stack the boom as it is hauled aboard.

Design and engineering

C-730-76
OIL BOOM FENDER

Anon. 1975.
Product Information

The Harbor Hoop oil boom fender is a high-strength, lightweight, floating ring which helps contain oil. When combined with the Hoop Skirt™, it functions as a floating oil and water separator. This equipment is manufactured by Nielsen Marine Products, Inc.

Design and engineering

C-731-76
OIL BOOM FENDING TOOL GUARDS VESSELS (product information)

Anon. 1976.
The Oil and Gas Journal 74(5):94.

Harbor Hoop oil boom fenders are lightweight, high-strength floating rings used instead of anchors to keep oil booms away from hulls and propellers. The fenders are easier to use, more reliable and more durable than anchors.

C-732-76
SLICKBAR (product information)

Anon.
Slickbar, Inc., 250 Pequot Avenue, P.O. Box 139, Southport,
CT. 06490

Slickbar, Inc., manufactures a variety of booms to be used even under the most adverse wind and wave conditions. The skirt material is designed to be flexible in the horizontal plane and "rigidized" in the vertical plane. The company also makes Slickskin Oil Recovery Units, shaped like manta rays, and a vacuum/transfer unit for oil spill recovery.

Design and engineering

C-733-76
DEVICE FOR COLLECTING LIQUID POLLUTANTS FLOATING ON A WATER SURFACE

Ayers, R. R., and E. V. Seymour. 1975.
British Patent 1,403,611

The device consists of two elongated floatable members and an interconnecting barrier. The barrier lies beneath the body of water. The members are spaced apart in the direction of relative water movement. This defines an open water-containing zone between the members and barrier means within which the pollutant can be captured.

Design and engineering

C-734-76
BARRIER

British Petroleum Co. Ltd. 1974.
Netherlands Application 7,415,179

A barrier which prevents spilled oil from spreading on water contains an air tube and an interconnected water tube. The structure has a "figure 8" cross section and floats in the water with the connection between the air and water tubes just above the water surface. Flexible reinforcing elements, connected to each tube, makes recovery of the barrier easy.

Design and engineering

C-735-76
AN IN SITU INVESTIGATION OF OIL BARRIER SHAPE AND DRAG COEFFICIENTS

Larrabee, R. M., and G. A. Brown. 1974.
Final report, USCG-D-161-75, Contract DOT-CG-33962-A. 219 p.
[AD-A017 099/3GA]

The objectives of this research were to determine the influence of current and wave action on oil barrier shape, and to compare previous tension and drag coefficient data with the present study. Shape, load, current, and wave data are all factors in the calculation of the drag coefficient for the boom. Actual barrier shape is closely approximated by a catenary curve.

Design and engineering

C-736-76
APPARATUS FOR THE COLLECTION OF OIL FROM THE SURFACE OF WATER

Mikander-Malmberg, D. 1975.
British Patent 1,419,106

This invention consists of a sheet of deformable material, a float around the entire periphery of the sheet, and a device to elevate part of the sheet so as to define a closed chamber bounded by the sheet, the float and the water surface.

Design and engineering

C-737-76
IMPROVEMENTS IN OR RELATING TO MARINE BOOMS FOR CONTROLLING FLOATING POLLUTION

Sandford, W. H. 1975.
British Patent 1,406,445

The boom for controlling floating pollution such as oil consists of an inflatable tubular buoyancy member, a flexible skirt extending downward from it, and a footrope attached to the bottom edge of the skirt to hold the boom between terminal points. When the boom is in place and opposed to flow, the skirt curves downward from the buoyancy member and forward toward the footrope and presents an upward inclined face to the forces of the flow which serves to hold the skirt down.

Design and engineering

C-738-76

A METHOD OF TREATING AN OIL-POLLUTED WATER SURFACE TO PREVENT THE SPREAD OF THE OIL POLLUTANT

Scott, P. R., and P. E. Titus. 1975.
British Patent 1,413,148

The method consists of applying a composition, containing at least one primary long-chain aliphatic alcohol having 10 to 20 carbon atoms per molecule, with a liquid and/or solid diluent material.

C-739-76

IMPROVEMENTS IN FLOATABLE OIL FENCES

Suzuei Co. Ltd. 1975.
British Patent 1,416,978

This floatable oil fence prevents the spreading of oil on a water surface and consists of an inflatable hose having a dorsal fin and a ventral fin. The hose has at least one partition positioned between the fins to divide the interior of the hose into at least two parallel longitudinal chambers.

Design and engineering

2. CLEANUP AND RECOVERY

C-740-76
AFL AUTOMATIC SKIMMER (product information)

Anon. 1975.

The AFL automatic skimmers utilize the principle of specific gravity differential between water and oil; as a result, the unit floats higher in water than oil. The unique float design allows the skimmer to rise and fall with fluctuating water levels and to continuously skim oil at a pre-set rate. FFI contact R. Graffia, AFL Industries, Inc., 1149 Howard Dr., West Chicago, Illinois 60185.

C-741-76
ANTI-POLLUTION CHEMICALS (product information)

Anon. 1976.
Industrial Wastes Information Bulletin 6(3):#HMS 5807.

The brochure lists a range of chemical products for oil dispersion, oil-water separation, odor masking, paint removal, industrial cleaning and hygiene. FFI contact H. G. Anti-Pollution Chemicals Ltd., 671 Bilsland Dr., Glasgow, 620 9NE.

Waste treatment and disposal methods

C-742-76
ASTM GETS INVOLVED IN SPILL-CONTROL SYSTEMS (news brief)

Anon. 1976.
National Petroleum News 68(1):67.

The American Society for Testing and Materials has established a committee to investigate oil spill-control systems. Such matters as test methods, specifications and performance, durability and strength of spill control systems will be studied.

Design and engineering

C-743-76
BP'S TON UP OIL SKIMMER IS NOW IN SERVICE

Anon. 1975.
Pollution Monitor (23):34-36.

An oil skimming system developed by British Petroleum is based on a controlled drift concept. Seapack, the boat, deploys a boom with drogues that drifts at 2% of wind speed. Oil moves at 3% of wind speed, moving into and concentrating in the boom. The boom can also be used to "sweep" an oil slick or contain it until the Seaskimmer can be used to pick up the oil.

Containment, Design and engineering

C-744-76
CHEMICAL CLEANING PRODUCTS (product information)

Anon. 1975.
Industrial Wastes Information Bulletin 6(1):#HMS 5409.

A wide range of cleaning products is described, including degreasers, bacteriocides, tar, concrete and polymer removers, sealants, oil dispersants, and absorbent booms for oil pollution control. FFI contact Arrow Chemicals Ltd., P.O. Box No. 3, Stanhope Rd., Swadlincote, Nr. Burton on Trent, Staffs.

Containment

C-745-76
COMPLETE OIL PROTECTION EQUIPMENT LAUNCHED IN SCANDINAVIA

Anon. 1975.
Scandinavian Oil and Gas Magazine 3(7-8):#35-36.

The oil protection equipment produced by the American Company, Pacific Pollution Control, is described. The equipment consists of a fence, the Aqua Fence; a fenced middle section of perforated metal screen, the Aqua Screen; and oil-absorbing materials, collection equipment and oil magnets.

Design and engineering

C-746-76
CONFERENCE OF THE BRITISH COLUMBIA WATER AND WASTE ASSOCIATION, VANCOUVER, B.C., 1974.

Anon. 1974.
British Columbia Water and Waste Association. 272 p.

The topics of the papers presented at this conference include water resources, role and responsibilities of the Environmental Protection Service (Canada), and oil spill technology. Treatment methods are evaluated. Canadian drinking water standards and the program objectives of the provinces were discussed by a panel.

C-747-76
OIL AND ESTUARY POLLUTION CONTROL

Anon. 1975.
Waste & Waste Treatment 18(7):24-28.

This brief look at developments in pollution control includes: oil/water separation, the application of the plate separator, a report on the 1975 Conference on Prevention and Control of Oil Pollution, automatic separation of oil from waste, control of oil slicks, absorbent for land and water, 'wringing' machines and booms, an oil sorbent up to 30x its weight, and the Port of Dunkirk pollution control boat.

Waste treatment and disposal methods, Reporting

C-748-76
OIL MOP SPILL CLEAN-UP SYSTEM (product information)

Anon. 1976.
Industrial Wastes Information Bulletin 6(1):#HMS 5289.

This system consists of feather-like plastic whiskers on a continuous belt which absorb oil and reject water. Oil is recovered by using squeeze rollers. The device is used for spill cleanup and oil recovery from low yield wells.

Design and engineering

C-749-76
OIL SKIMMER (product information)

Anon. 1975.
Journal Water Pollution Control Federation 47(12):858a.

The Model TS-100 oil skimmer operates on the endless belt principle without the use of pumps or vacuum. Oil accumulated in a sump or tank can be collected and discharged, reducing oil content to trace residuals. FFI contact Tenco Hydro/Aerosciences, Inc., 5220 East Ave., Countryside, Ill. 60525.

Design and engineering

C-750-76
PLENTY OF ACTION FOR THESE COAST GUARDSMEN

Anon. 1974.
World Ports 36(5):21-23.

The U.S. Coast Guard station in New York was able to contain the oil spill from a collision of 2 ships in 1973. The pollution abatement section is responsible for cleanup, and contains 5 officers and 22 men. More than 600 navigational aids are also used. The station carries out drug raids, safety patrols, harbor search and rescue missions, firefighting, and icebreaking.

Containment, Oil transfer and transport

C-751-76
POLLUTION CONTROL ASSOCIATION OF ONTARIO: 1974 ANNUAL CONFERENCE

Anon. [1974?]
Abstracts. 22 p.

The abstracted papers deal with environmental degradation, and the impact of environmental assessment and legislation. Specific subjects covered include the handling of oil spills, concepts in urban drainage design, industrial waste treatment, and automated chemical analysis for water quality measurements.

Waste treatment and disposal methods

C-752-76
POLLUTION CONTROL DIRECTORY 1975-76

Anon. 1975.
Environmental Science and Technology 9(11):88p.

This pollution control directory consists of nine sections: laboratory supply houses, instruments and equipment, chemicals (manufacturers listed), professional consulting services, services (companies which offer services, distributers, etc.), environmental books, trade names, company directory, and advertiser index.

C-753-76
PROVING OUT POLLUTION CLEAN UP

Anon. 1975.
Surveyor 9(1):16-19.

The EPA testing tank (OHMSETT) has oil tanks and spreading equipment. The tank walls are protected by a bubble system to save cleanup expense. Waves up to 2-1/2 ft. tall and 100 ft. long and 6-kt currents can be produced. Oil cleanup equipment has been tested; the extent and accuracy of the test data are excellent.

Containment, Design and engineering

C-754-76
SLICKBAR AND SLICKSKIN (product information)

Anon. 1976.
Industrial Wastes Information Bulletin 6(2):#HMS 5569.

Floating pollution and debris are contained using slickbar booms. Skimmer heads and pumps used in Slickskim oil recovery systems and Conwed oil spill sorbents are described. FFI contact Furmanite International Ltd., Dockray Hall Road, Kendal, LA9 4RX, Cumbria.

Design and engineering, Containment

C-755-76
SLICK IDEA FOR OIL-SPILL CLEANUP (news brief)

Anon. 1975.
Chemical Week 117(26):11.

A new oil-spill cleanup system, called the "mechanized sorbent oil spill recovery system," can collect 50,000 gal/hour by making use of 3.6 million absorbent urethane foam chips. The chips are cast from a barge in a 6 m swath across the spill. The barge scoops up the saturated chips and passes them to a generator where they are squeezed dry for reuse.

Design and engineering

C-756-76
SPILL UNITS

Anon. 1974.
Offshore 34(11):120.

Vac-U-Max has developed an oil skimming unit functioning on high pressure air and designed to promptly handle oil spillage and cleanup under normal or emergency conditions.

Design and engineering

C-757-76
WHEN IS A WHALEBOAT LIKE A CRUISER?

Anon. 1975.
ASTM Standardization News 3(7):26.

Article briefly describes the development of a newly evolved ASTM committee on oil spill control systems, composed of containment, recovery and treatment subcommittees and an administrative task force.

Containment, Contingency planning

C-758-76
ENVIRONMENTAL ACTION AT PORT AUTHORITY AIRPORTS

Attar, A. M. 1974.
International Conference on Waste Oil Recovery and Reuse, Washington, D.C., 1974. Washington, D.C., Information Transfer, Inc. p. 99-116.

The Port Authority of New York and New Jersey, with the aid of Calspan Corporation, Buffalo, is conducting a comprehensive program to protect and improve the environment around airports under its jurisdiction. Short-term control measures and long-term preventive solutions are given. Installation of skimmers and booms to aid in oil spill detection and cleanup are among the long-term recommendations.

C-759-76
DEVELOPMENT OF A HIGH SEAS OIL RECOVERY SYSTEM, PHASE II, APPENDIX I. DESIGN STUDIES AND SPECIFICATIONS

Beach, R. L., F. A. March, L. S. Brown, T. S. McMahon, and J. Papp. 1974.
U.S. Coast Guard Report No. CG-D-84-74. 180 p. [AD/A-003 934]

A prototype oil spill recovery system has been designed and constructed. This report describes studies which evaluated materials for their potential use in rigid elements of the weir/basin, the pressure drop for different oil transfer hose configurations, and alternate ways to deploy and recover the oil recovery apparatus. Specifications for construction and specific components of the apparatus are listed in the latter part of the report.

Design and engineering

C-760-76
DEVELOPMENT OF A HIGH SEAS OIL RECOVERY SYSTEM, PHASE II, APPENDIX II. MATERIALS AND COMPONENT TESTS

Beach, R. L., F. A. March, L. S. Brown, T. S. McMahon, and J. Papp. 1974.
U.S. Coast Guard Report No. CG-D-84-74. 232 p. [AD/A-003 946]

Studies which evaluated the subsystems and components of the oil recovery system are described. A full-scale model of the secondary weir was tested using four different weight oils. The oil resistance of the materials, maximum expected load on the intermediate flotation section, the control system, and the oil-water interface sensor are areas examined.

Design and engineering

C-761-76
METHOD OF REMOVING OIL FROM WATER USING RICE HULLS

Bertram, L. E. 1975.
U.S. Patent 3,902,998

Rice hulls are floated on oil-contaminated bodies of water to absorb the oil. After the rice hulls have become loaded with contaminant, they can be skimmed from the water surface or removed by centrifugal or rotary pumps which provide suction lift.

C-762-76
STUDIES FOR THE PREVENTION OF OIL POLLUTION NEAR BRATISLAVA, CZECHOSLOVAKIA

Blair, A. H. 1974.
Groundwater Pollution in Europe, Reading, England, 1972.
J. A. Cole (ed.). p. 332-337. Conference of the Water Research Association.

The prevention of groundwater pollution by oil leaks and spills from the refinery at the divergence of the Danube and Little Danube is discussed. Another source of pollution is induced recharge of the groundwater by the oil polluted waters of the River Danube.

Waste treatment and disposal methods

C-763-76
DISPERSANT COMPOSITION FOR SPILLED OIL

Blanchard, P. M., and D. G. Meeks. 1975.
German Offenlegungsschriften (unexamined patent application) 2,454,932

The composition of the oil dispersant is as follows: an ester of a polyethyleneglycol and a C_{10}-C_{24} fatty acid [$RCO_2(C_2H_4O)XH$, where R is a C_{9-23} alkyl or alkenyl residue and X is 3, 4 or 5], a surfactant alkyl or Na, NH_4^+, amino or amino alcohol salt, and an alcohol or glycol with a molecular weight of 90-250.

C-764-76
EMULSIFYING OIL SPILLS

Blanchard, P. M., and A. A. J. Mundye. 1975.
British Patent 1,399,860

"Water-insoluble poly (oxyethylene glycol) monoleate dissolved in kerosene is a useful dispersant for oil slicks."

C-765-76
IMPROVEMENTS IN THE REMOVAL OF SURFACE LAYERS FROM LIQUIDS

Bremner, W. A. 1975.
British Patent 1,402,635

The apparatus consists of a suction head adapted to be carried at an open inlet end of a conduit connected with a source of suction. The arrangement is designed so that a surface layer can enter the conduit only after passing radially inward through the inlet slot.

C-766-76
SYSTEM FOR THE RECOVERY OF OIL

Brown, C. E., and A. Gollan. 1975.
French Patent 2,247,379

This apparatus is mounted on a ship and is intended to clean waters in harbors. It consists of a recovery chamber on board ship and plates ahead of the chamber which reduce the velocity of water, preventing the water from carrying the oil under the ship.

Design and engineering

C-767-76
RHEINWERFT OIL SKIMMER PLANT (product information)

C. A. Bekhor Ltd. 1975.
Industrial Wastes Information Bulletin 5(5):#HMS 4866.

Skimmer sizes range from small portable units to custom built crafts handling up to 40 cu. meters per hour. The method predominantly recovers oil rather than oil-water mixtures. FFI contact C. A. Bekhor Ltd., 29 St. James's St., London, SWIA 1HB.

Design and engineering

C-768-76
CONTAINMENT, COLLECTION AND RECYCLING OF OILY WASTES

Dalton, T. 1974.
International Conference on Waste Oil Recovery and Reuse, Washington, D.C., 1974. Washington, D.C., Information Transfer, Inc. p. 91-97.

A review of the problems of containing, collecting and recycling oily wastes is provided. An oil spill contingency program should be devised for plants to use in emergency spill situations. Materials and equipment used to contain and clean up oil spills are described. Suggestions for the handling of collected oil are given.

Containment, Contingency planning, Reclamation and reuse

C-769-76

OIL DISPERSANT

Dulaney, C. L., and D. J. Hagney. 1975.
Canadian Patent 969,445

Addition of this dispersant to an aqueous medium containing floating oil causes the interfacial tension between oil and water to be decreased so that the oil is dispersed. The preparation of the dispersant is outlined.

C-770-76

DECONTAMINATION OF WATER CONTAINING LIPOPHILIC SUBSTANCES

Farbwerke Hoechst AG. 1974.
German Patent 2,248,832

Pesticide and oil pollutants may be removed from ground or surface water by flocculation with ethylene polymers containing monomers. Potable water is claimed to result.

Waste treatment and disposal methods

C-771-76

FLOATING VEHICLES FOR REMOVING OIL AND OTHER FLOATING SUBSTANCES FROM THE SURFACE OF THE WATER

Fast, S. G. 1975.
German Patent 2,341,177

This vehicle consists of two separate hulls attached at a certain distance from each other, and a conveyor belt mounted between the hulls of the catamaran. The belt, driven by a reversible motor, may be vertical or inclined by an angle between 20° and 30° with respect to the surface of the water.

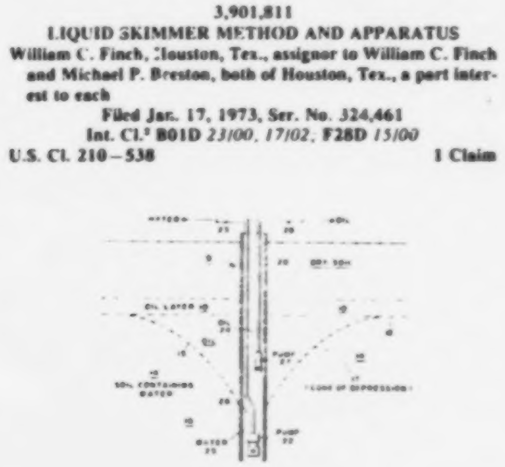
Design and engineering

C-772-76
LIQUID SKIMMING METHOD AND APPARATUS

Finch, W. C. 1975.
U.S. Patent 3,901,811

The skimmer has a closed end positioned below the interface of two liquids to form a storage reservoir; it has at least one port extending above the interface. The overlying liquid flows through the port into the reservoir from which it is removed. The invention can be used for mechanically separating oil from water in almost any environment.

Design and engineering



3,901,811
LIQUID SKIMMER METHOD AND APPARATUS
William C. Finch, Houston, Tex., assignor to William C. Finch and Michael P. Breston, both of Houston, Tex., a part interest to each
Filed Jan. 17, 1973, Ser. No. 324,461
Int. Cl.² B01D *23/00, 17/02;* **F28D** *15/00*
U.S. Cl. 210–538 **1 Claim**

CONE OF DEPRESSION

C-773-76
ROTARY OIL RECOVERY DEVICE WITH NON-INTEGRAL COLLECTING HEAD

Galicia, F. 1975.
U.S. Patent 3,907,684

A floating recovery device applicable for the retrieval of oil from bodies of water is described. The intake of contaminated liquid is regulated by a rotatable collecting head driven at a variable speed ratio to the remainder of the separation apparatus. A filter to filter out debris is also present.

Design and engineering

C-774-76
PROCEDURE TO SUCK UP OIL

Hoechst AG. 1974.
Netherlands Application 7,414,933

The invention uses a fine-particle, oil-absorbing mass characterized as a powder or strip foils of the glycol ester of polyterephtal acid or nitroresin-coated cellophane foils. With this procedure, oil or hydrocarbons can be sucked up from water surfaces, from water and from the bottom.

C-775-76
PROCEDURE TO SUCK UP OIL

Hoechst AG. 1974.
Netherlands Application 7,414,934

The procedure uses a modified cell material consisting of small particles to suck up oil, in particular hydrocarbons, from the water surface, from the water and from the bottom. The cell mass is modified with an organic isocyanate, a high molecular weight fatty acid, an ester of a high molecular weight fatty acid, and a complex compound of a high molecular weight fatty acid.

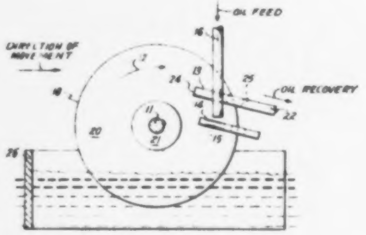
C-776-76
RECOVERY OF OIL AND OIL-SOLUBLE CONTAMINANTS FROM THE SURFACE OF WATER

Hoegberg, R. G., and W. S. Tyler. 1975.
U.S. Patent 3,905,902

Negatively electrostatically charging hydrophobic rotating disks immersed in water are used to recover oil from water with minimum water pickup. Oil is applied to the disk to help maintain the change in the oil phase and to remove thin films of oily material which contain oil-soluble contaminants from the water surface.

Design and engineering

3,905,902
RECOVERY OF OIL AND OIL-SOLUBLE CONTAMINANTS FROM THE SURFACE OF WATER
Ruth G. Hoegberg, 209 Matrey La. Wallingford, Pa. 19086, and Walter S. Tyler, Valley View, R.D. No. 1, Landisburg, Pa. 17040
Continuation-in-part of Ser. No. 180,729, Sept. 15, 1971, abandoned. This application Sept. 10, 1973, Ser. No. 395,683
Int. Cl.^{2} B01D 15/00
U.S. Cl. 210–30 10 Claims



C-777-76
REMOVAL OF OIL FROM SURFACES OF WATER, ETC.

Holst, A., M. Kostrzewa, H. Lask, and G. Buchberger. 1975.
German Offenlegungsschriften (unexamined patent application)
2,358,808

Treated finely divided cellulose products can adsorb oil slicks, oil-contaminated water, and oil spills. Shredded paper or sawdust is treated with organic isocyanates, high molecular weight fatty acid derivatives or methylolmelamine derivatives.

C-778-76
REMOVAL OF OIL FROM SURFACES OF WATER, ETC.

Holst, A., M. Kostrzewa, H. Lask, and G. Buchberger. 1975.
German Offenlegungsschriften (unexamined patent application)
2,358,820

Oil adsorbents composed of powders or chopped sheets of polyterephthalic acid glycol ester can be used to remove oil slicks, oil-contaminated water or oil spills. Sheets of glass foil covered with synthetic resin varnish are also effective.

C-779-76
PROCEDURES TO DISPERSE OIL IN WATER AND TO PREPARE COMPOUNDS TO DO SUCH

Imperial Chemicals Inds. Ltd. 1975.
Netherlands Application 7,500,562

Spilled oil and water are brought into contact with an alkyd resin having one component containing the residue of a polyalkyleneglycol, which is soluble in water.

C-780-76
IMPROVEMENTS IN AND RELATING TO A DEVICE FOR REMOVING OIL SLICKS

Ivanoff, A. 1975.
British Patent 1,405,560

The device is a water craft consisting of an open hull with side walls which channel oil entering between them toward a stern wall. A means for removing oil accumulating within the craft is provided. An antisurging device, which reduces the amplitude of waves so as to calm the oil covered water within the hull, is mounted between the side walls.

Design and engineering

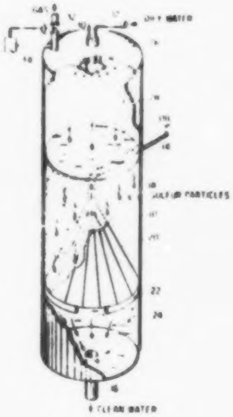
C-781-76

OIL SEPARATOR WITH COALESCING MEDIA

Jones, L. W. 1975.
U.S. Patent 3,893,925

A system for removing dispersed oil from water depends on the oily water flowing downward through a granular sulfur filter. The sulfur causes the oil to coalesce, and move through channels to the top of the filter. Oil free water is drawn off at the bottom.

3,893,925
OIL SEPARATOR WITH COALESCING MEDIA
Loyd W. Jones, Tulsa, Okla., assignor to Amoco Production Company, Tulsa, Okla.
Filed Aug. 16, 1971, Ser. No. 171,822
Int. Cl. B01d *17/04*
U.S. Cl. 210—266 **9 Claims**



C-782-76

USE OF A SIMPLE EXPERIMENTAL DEVICE TO STUDY WATER POLLUTION IN SITU: COMPARATIVE EFFECTS OF THREE ANTI-PETROLEUM EMULSIVE AGENTS

Lacaze, J. C. 1974.
Environmental Protection Agency, NTIS PB-237 784-T. 23 p.

A lagoon in the Sables d'Olonne region was sectioned off into natural environmental compartments to be used for pollutant treatments and controls. Of the three products tested, Corexit produced weak and temporary changes, Sefoil fertilized the water, and Gamosol inhibited photosynthesis.

Biological effects of oil pollution

C-783-76
ULTIMATE DISPOSAL OF SPILLED HAZARDOUS MATERIALS

Lindsey, A. W. 1975.
Chemical Engineering 82(23):107-114.

The disposal of spilled hazardous materials is discussed in regard to management of the incident, selection of disposal options and a suitable landfill method for disposal of spilled materials (including oil).

Waste treatment and disposal

C-784-76
A DEVICE FOR COLLECTING OIL FROM WATER SURFACES

Luopajarvi, E. 1975.
British Patent 1,410,263

The apparatus consists of a hollow frustum with an inlet opening which has an area larger than that of an outlet opening. The frustum is mounted peripherally on a rotatable drum with the inlet opening at the periphery of the drum. A collecting device is coordinated with the outlet opening, and is located inside and toward the center of the drum.

Design and engineering

C-785-76
METHOD FOR COMBATTING POLLUTION USING A CHROMIUM COMPLEX

Martineau, J., and F-J. Biechler. 1975.
U.S. Patent 3,886,070

A chromium complex is attached to solid particles of a metallic aluminosilicate. This mixture is dried, then spread over oily water at a concentration of 1-4 parts of the mixture to 1 part (by weight) of the oil. The oily product forms a floating paste which is removed by skimming.

C-786-76
PADDLEBOAT GIVES A CLEAN SWEEP TO OIL POLLUTION (news brief)

McLain, L. 1975.
Engineer 240(April 10):11.

The Lockheed Ocean Systems' Clean Sweep system resembles a Mississippi style paddle boat, but with a non-propulsive wheel amidships. The oil adheres to the rotating disc blades of the wheel, and is scraped off into a central sump tank at a rate of 200 gallons of oil a minute. Both large units and small industrial units are available.

Design and engineering

C-787-76
EFFICIENCY OF OIL-SPILL REMOVERS

Michel, P. 1974.
Environmental Protection Agency, NTIS PB-237 900-T. 32 p.

A comparison of 101 commercial products used in combating oil pollution was made. The products react with hydrocarbons in one of three ways. Emulsifiers convert the oil to a fine emulsion which is easily biodegradable. Agglomerants absorb hydrocarbons, facilitating recovery. Precipitants cause the oil to settle on the bottom.

C-788-76
TECHNOLOGICAL ASPECTS OF THE PREVENTION, CONTROL, AND CLEANUP OF OIL SPILLS

Milgram, J. H. 1974.
Oil Spills and the Marine Environment. Cambridge, Mass., Ballinger, 1974. p. 57-110.

Tankers, wells and pipelines are considered as sources of pollution. Tanker pollution can be minimized by using Load-on-Top procedures. Support casings, drilled mud, and blowout preventers are used in drilling wells. Pipelines can be inspected frequently to prevent pollution. Different cleanup devices and chemical agents are described.

Oil transfer and transport

C-789-76
IMPROVEMENTS IN AND RELATING TO COMBUSTING FLAMMABLE LIQUID WASTES

Moskovsky Nauchnoissledovatesky Proektnoizysk Institut Mosvodokanalniiproekt. 1975.
British Patent 1,384,720

Air is injected into a layer of waste causing it to rotate, and a vortex is produced. Oil is burned with 60% water without homogenizing. The floating version is suitable for oil spills in port.

Waste treatment and disposal methods

C-790-76
REMOVAL OF OIL SLICKS FROM WATER - BY SCATTERING RUBBER POWDER FROM OLD TYRES ON THE OIL AND COLLECTING

Nittan Co. Ltd. 1974.
German Patent 2,338,235

Oils are absorbed by powdered rubber from ground tyres. Wave action causes oil balls to form, which are readily collected. Oil may be processed with asphalt to yield improved road surfacing composition.

Reclamation and reuse

C-791-76
OIL SLICK DISPERSANT

Noble, R. 1975.
British Patent 1,404,684

A nontoxic oil-slick dispersant, sprayed at a concentration of 1:1::oil:dispersant, dispersed oil in less than 1 minute. The time depended on the degree of agitation. The dispersant is 86% (volume) kerosine, 9% polyoxyethylene glycol monooleate, 3% sorbitan monooleate, and 2% monopropylene glycol.

C-792-76
OIL DISPERSING AGENT

Osborn, P. G., P. F. Nicks, and M. G. Norton. 1975.
German Offenlegungsschriften (unexamined patent application)
2,501,802

Oil is effectively dispersed in water by the use of alkyd resins containing polyalkylene glycols. Alkyd resin in a ligroine solution containing 75% solids was mixed with an equivalent weight of ethylene glycol monobutyl ether. This solution dispersed 1 ml crude oil floating on the surface of 1.5 l of a 3.5 wt. % NaCl solution in 13 minutes.

C-793-76
OPEN WATER PURIFICATION SYSTEM

Rafael, J. 1974.
French Patent 32834V/18

This open water purification system is capable of cleaning up oil slicks. Water is taken in at the bow, mixed with a flocculating agent, then sent through a duct to a separation system. The separation system handles the precipitated sludge and has an aft discharge port for the treated water.

Design and engineering

C-794-76
OIL SPILL TECHNOLOGY

Ross, S. L. 1974.
Conference of the British Columbia Water and Waste Association, Vancouver, B.C., 1974. p. 125-141.

The state of preparedness for a spill depends on the contingency plan, personnel training, and the availability of good equipment. Most of the technology and methods currently in use are inadequate in effectiveness, labor requirements or sophistication. Development is required in the detection, containment and recovery of oil spills, and in the restoration of beaches. Guidelines for evaluation of new technology are given.

Restoration, Contingency planning

C-795-76
PROTOTYPE HIGH-SEAS DISC-DRUM OIL RECOVERY SYSTEM

Scharfenstein, C. F., and W. T. Beran. 1975.
Final report, USCG-D-150-75, Contracts DOT-CG-24231-A, DOT-CG-32782-A. 247 p. [AD-A017 000/1GA]

The oil recovery system was designed to recover up to 1,000 gpm of a variety of oils in Sea State 4. A catamaran made of inflatable pontoons floats the disc-drum recovery unit; pumps and power systems are in the twin hulls and connecting cross structure. The system is remotely controlled, refueled and monitored through an umbilical attached to the tender, which also receives the oil. The system is transportable by a variety of aircraft, trucks and ships.

Design and engineering

C-796-76
TESTS OF OIL RECOVERY DEVICES IN BROKEN ICE FIELDS. PHASE I.

Schultz, L. A., P. C. Deslauriers, R. P. Voelker, O. M. Halstad, and D. E. Abrams. 1975.
Final report No. 228-C USCG-D-130-75, Contract DOT-CG-51487-A. 91 p. [AD-A016 465/7GA]

Full size tests of the Lockheed Clean Sweep Model R 2003 and the Marco Pollution Control Class 1 Oil Recovery System are reported. Tests using No. 2 diesel oil and crude oil were done in a simulated Arctic environment in broken freshwater ice and saltwater ice. Only minor hardware modifications are needed in order for both models to recover spilled oil in an ice field of moderate icepiece size.

Design and engineering

C-797-76
COATINGS MAY PROTECT BEACHES AGAINST OIL

Seltzer, R. J. 1975.
Chemical & Engineering News 53(49):30-31.

The article describes the state of research on the surface treatment of shorelines with chemical agents to prevent contact of spilled oil with shoreline materials. Studies involve applying chemical coatings before an oil spill hits shore. The coating creates a barrier which prevents oil adherence, staining, absorption and contamination; oil can then be readily removed.

C-798-76
APPARATUS FOR THE RECOVERY OF OIL AND OTHER OILY SUBSTANCES

Tezuka, T., H. Kawakami, and K. Miura. 1975.
French Patent 2,246,695

This floating device consists of a vertical plate, an attached float, flexible watertight connections with other vertical plates, and directional control means forcing the device to form a certain angle with the direction in which it is being towed during recovery of the oil spill.

Design and engineering

C-799-76
ADSORBENTS FOR REMOVAL OF OILS FROM SEA AND RIVER WATERS

Toda, S., H. Uchiyama, and H. Kimura. 1975.
Japanese Kokai (unexamined patent application) 75,106,891

Synthetic fiber sheets or plastic foams are impregnated with condensates prepared from polyols and benzaldehyde-hydroxybenzaldehyde mixtures, water-miscible, polar organic solvents in which the condensates are soluble, and organic liquids which are soluble in the polar organic solvents and immiscible with water. In one test, a polyethylene fiber sheet completely absorbed 10 ml crude oil floating on 300 ml water in five seconds.

C-800-76

CHARACTERISTICS OF OIL POLLUTION IN AND AROUND U.S. WATERS

Van Voorhis, P. W. 1974.
International Conference on Waste Oil Recovery and Reuse, Washington, D.C., 1974. Washington, D.C., Information Transfer, Inc. p. 207-224.

The oil pollution problem in the U.S. today, and the U.S. Coast Guard's growing program to combat it are discussed. The program concentrates on oil discharged in U.S. waters between 1970 and 1972, frequency, volume, causes and characteristics of these discharges, and the problem and expense associated with removal.

Economic effects of oil pollution, Contingency planning, Reporting

C-801-76

ENVIRONMENTAL POLLUTION CONTROL (product information)

W. S. Atkins Group. 1975.
Industrial Wastes Information Bulletin 5(5):#HMS 4917.

A large firm of consulting engineers provides a comprehensive range of services for the treatment and control of sources of pollution.

C-802-76

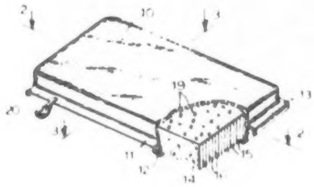
PICK-UP ELEMENT FOR OILY CONTAMINANTS

Yocum, C. H. 1975.
U.S. Patent 3,904,528

The element has an outer container of porous material which is permeable to liquid oily contaminants and impervious to water. An absorber positioned in the container is composed of spongy material which absorbs oil contaminants; it has large spaced parallel surfaces and a number of slits in the direction of the thickness of the absorber. Granules of absorbent material are sprinkled over the surfaces of the absorber.

Design and engineering

3,904,528
PICK-UP ELEMENT FOR OILY CONTAMINANTS
Charles H. Yocum, 463 Adamsville Rd., Westport, Mass. 02790
Filed June 29, 1973, Ser. No. 374,886
Int. Cl. C02b 9/02
U.S. Cl. 210—242 **8 Claims**



3. RESTORATION

C-803-76
FIFTH ANNUAL REPORT

Newcastle-upon-Tyne, University. Advisory Committee on Oil Pollution of the Sea. Research Unit on the Rehabilitation of Oiled Seabirds. 1974.
Annual report, 1974. 28 p.

Rapid treatment with adequate facilities, immediate feeding and early return to the outdoors are important factors in rehabilitating seabirds contaminated with oil. Data from the recent restoration attempts include the percentage of birds waterproofed, the correlation of diet and waste, cause of death, and guillemot behavior.

Biological effects of oil pollution

C-804-76
OPERATION WATERFOWL

Stanton, P. date unknown.
API Publication

Summary not available.

C-805-76
THE DAY THE BIRDS WEPT

Watkins, T. H. 1976.
Audubon 78(1):17-21.

The author describes his personal experiences with beach cleaning and bird rescue centers in San Francisco Bay when a tanker collision occurred in January, 1971. Of the 4,629 birds treated, 94% were lost; uncounted thousands washed out to sea or sank.

Biological effects of oil pollution, Cleanup and recovery

4. OIL TRANSFER AND TRANSPORT

C-806-76
DUNLOP "SAFLOTE" INTEGRAL FLOATING OIL HOSE (product information)

Anon.
Wood, D. B., William Wood & Associates, P.O. Box 7886, Metarrie (New Orleans), Louisiana 70011 (exclusive U.S. representative of Dunlop Limited)

Dunlop's offshore hose is used at monobuoy terminals. If the primary carcass fails, the oil is contained by the secondary carcass which swells by about 35%, signaling the need to replace the hose. The hose is still functional and will last until the tanker is cleared.

Design and engineering

C-807-76
ENVIRONMENTAL PROGRESS AT FAWLEY REFINERY

Anon. Winter 1974/1975.
Esso Magazine V4404:4-11.

Work is being done to minimize contamination of water by oil during docking of tankers and in the refinery. Efforts are also being made to reduce noise and odors.

Waste treatment and disposal methods

C-808-76
THE FINDINGS

Anon. 1974.
Pacific Northwest Sea 7(3-4):8-23.

The findings of the Oceanographic Commission of Washington on the feasibility of offshore petroleum transfer systems are discussed. Open ocean single point moorings would need breakwaters which are difficult to construct. Oil transportation policy in Puget Sound must be established. Costs, port alternatives, environmental and socioeconomic impacts, and oil spills are assessed.

General effects of oil prospecting and production. Economic effects of oil prospecting and production

C-809-76
STATEMENT ON REGULATIONS FOR SEAGOING TANK VESSELS RELEASED
(news brief)

Anon. 1975.
Sea Technology 16(12):28.

New Coast Guard regulations are aimed at reducing oil pollution from ships. New tankers in excess of 70,000 tons must have segregated ballast. Slop tanks and oily residue tanks will be required. Ballast water will not be allowed in the fuel tanks of new vessels. Copies of the statement can be obtained from Executive Secretary, Marine Safety Council, U.S. Coast Guard (CG-CMC/82), Washington, D.C. 20590.

U.S. legislation, Waste treatment and disposal methods

C-810-76
MARINE POLLUTION CONTROL: PART II - SHIP DESIGN REQUIREMENTS; SYNOPSIS OF THE PROBLEM AND ALTERNATIVE SOLUTIONS

Abbott, J. W. 1975.
Naval Engineers Journal 87:15-28.

This article provides an overview of the ever-increasing problem faced by designers of commercial vessels--that of meeting new national and international pollution control laws at minimal cost to the customer. Also discussed are alternative solutions available to the designer and operator of commercial vessels.

Waste treatment and disposal methods, Design and engineering

C-811-76
REGULATIONS FOR THE MOVEMENT BY ROAD OF HAZARDOUS GOODS

Bealby, R. 1974.
Chartered Institute of Transport. Journal 36(6):139-144.

"Regulations for rail, sea, air, and road transport of explosives, petroleum spirit, other dangerous goods and radioactive substances are described."

Foreign legislation

C-812-76
WHAT'S HAPPENING WITH MARINE ENVIRONMENTAL REGULATIONS

Brown, R. L., and T. H. Robinson. 1975.
Marine Technology, SNAME 12(3):275-280.

The U.S. Coast Guard is responsible for the establishment of adequate standards for various types of vessels to prevent or minimize the discharge of pollutants into U.S. waters. Standards dealing with tankship and tank barge design, tank slops, oily bilge wastes, spill containment and vessel sewage are discussed in this paper.

U.S. legislation, Waste treatment and disposal methods, Containment

C-813-76
CRUDE WASHING GUIDELINES

Castaldi, G., and W. J. Pow[e]ll. 1975.
Interim report on Task 1, MA-RD-930-76012, Contract C-5-38000. 25 p.
[COM-75-114 28/OGA]

Equipment requirements for washing crude oil tanks are discussed. Operation guidelines for planning and executing a safe, efficient operation without pollution and with minimal delay are also included.

Industry standards and guidelines

C-814-76
A TRIP ON A TANKER

Ensz, R. G. 1975.
Petroleum Today 1975(3):14-19.

The author's experiences on a Danish supertanker sailing from England to the Persian Gulf via South Africa are described. The captain of the VLCC indicated that international regulations prohibit the discharge of oil or oily mixtures within 50 miles of any coast and that most oil companies forbid the discharge of oil anywhere in the ocean.

International legislation

C-815-76
OIL PORTS ON THE CONTINENTAL SHELF

Flory, J. F. 1975.
Oceanus 19(1):45-55.

The use of very large tankers and offshore oil ports is the best solution to the problem of transporting large quantities of oil over long distances and still reducing environmental risks. The deepwater terminal with single point moorings is considered to be the most attractive type of port proposed. The single anchor leg mooring will be used in some of these terminals.

C-816-76
COLLISION-PROOF TANKS FOR FUEL OIL TRANSPORT

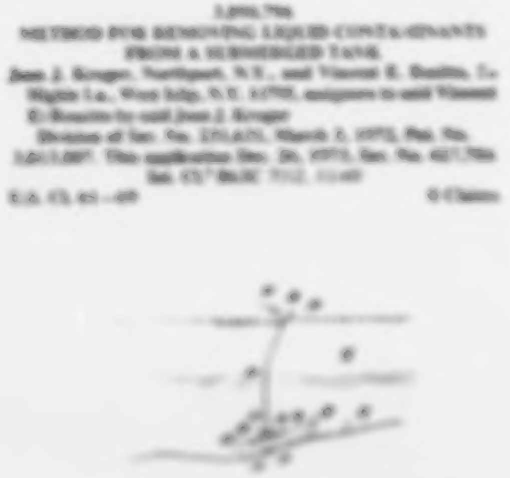
Frischknecht, F. 1974.
German Patent 2,260,397

Rigid tanks are divided into compartments which contain a flexible elastic bag for oil containment.

C-817-76
METHOD FOR REMOVING LIQUID CONTAMINANTS FROM A SUBMERGED TANK

Kruger, J. J., and V. E. Rossitto. 1975.
U.S. Patent 3,890,796

Two holes are drilled in the submerged tank. Each drilled area of the tank is isolated from the liquid so as to prevent it from contaminating the surrounding waters. One hole is positioned higher than the other hole; the liquid is pumped out from one of the holes while liquid surrounding the submerged tank enters the other hole.



C-818-76
CLEANER PORTS FOR THE AMERICAS

Langlois, A. E. 1974.
World Ports 36(5):15-16.

Many agencies are concerned with the problems of the port environment. Dredging and spoils disposal are probably the most critical problems affecting port development. Measures for the prevention, control and removal of petroleum spillage will be necessary in deepwater ports. A recent survey of 52 ports and waterways by the USCG found 22 that needed immediate attention.

General effects of oil prospecting and production

C-819-76
THE ONSHORE HANDLING OF OIL

Larminie, F. G. 1975.
Petroleum and the Continental Shelf of North West Europe.
H. A. Cole (ed.). Barking, United Kingdom, Applied Science Publishers, 1975. Vol. 2. Environmental Protection. p. 39-47.

The transport, stabilization and storage of hydrocarbons onshore are reviewed. Aspects concerning the possible effects of the oil industry on the environment are emphasized.

General effects of oil prospecting and production

C-820-76
WATER CONSERVATION IN SWEDEN III. CURRENT TRENDS

Lundkvist, S. 1975.
Journal Water Pollution Control Federation 47(4):673-674.

The history of water pollution prevention in Sweden is reviewed. Oil pollution is a major problem. Facilities for handling oily wastes have been increased, and the Coast Guard has developed special vessels and depots to handle the problem. Other sources of pollution and the actions taken to control them are discussed.

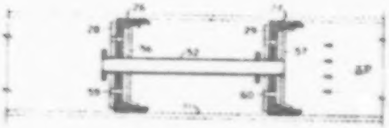
Waste treatment and disposal methods

C-821-76
METHOD OF LOCATING PIPELINE LEAKS WITH A ONE-WAY PIG

Matthews, J. F., Jr., and W. M. McDonald. 1975.
U.S. Patent [illegible]

A one-way pigging device is positioned at successive locations along the length of a pipeline by hydraulic pressure applied at one end of the pipeline. At each location testing pressure is introduced from the opposite end of the pipeline, thereby indicating the location of any leaks. The pig moves in response to a pressure differential in one direction and becomes anchored at a location in response to a pressure differential in an opposite direction.

3,903,730
METHOD OF LOCATING PIPELINE LEAKS WITH A ONE-WAY PIG
Jamie F. Matthews, Jr., and William M. McDonald, both of Houston, Tex., assignors to Exxon Production Research Company, Houston, Tex.
Filed Nov. 5, 1973, Ser. No. 413,008
Int. Cl.² G01M 3/08
U.S. Cl. 73—40.5 6 Claims



C-822-76
800 MILES TO GO

Merrett, R. H. 1975.
NLGI Spokesman 38(12):421-427.

The environmental effects of the Alaska pipeline are discussed; and water and air quality control facilities are described. All ballast water from oil tankers will be processed, and discharged into the harbor with less than 8 ppm of oil.

Waste treatment and disposal systems

C-823-76
A METHOD AND A DEVICE FOR PREVENTING LEAKAGE OF OIL FROM TANKERS IN THE EVENT OF GROUNDING

Polviander, N. G. R., and V. Kostilainen. 1975.
Helsinki University Report 5. 35 p.

Oil can be prevented from leaking through holes beneath the water line of grounded tankers. A vacuum is maintained in the cargo tanks of the ships, so that the total pressure outside the hole is always greater than inside. Data on tanker damages in the Baltic Sea, the Gulf of Bothnia, and the Gulf of Finland during 1960-1969 are included.

Reporting

C-824-76
SAFEGUARDING UPPSALA FROM OIL POLLUTION

Sidenvall, J. 1974.
Groundwater Pollution in Europe. J. A. Cole (ed.). Conference
of the Water Research Association, Reading, England, 1972.
p. 328-331.

Oil pollution can be caused by overflow of oil tanks, burst tanks, and corrosion of underground tanks and pipes. Usually most of the oil-polluted soil is removed. If oil has already reached the groundwater table, the flow must be reversed by pumping, and the oily water moved to settling tanks. Oil pollution on clays is most difficult to handle.

Cleanup and recovery

C-825-76
PIPE LINE WITH A SAFETY EQUIPMENT FOR TRANSPORTING PUMPABLE MEDIUMS

Siegmund, W. 1975.
U.S. Patent 3,907,336

"An annular chamber circumferentially embraces a circumferential welding seam between adjacent tube sections and the welded areas on both sides of the welding seams. There is a leak detector connected to the circumferential chamber for detecting and indicating any liquid leaking through a flaw in the welded seam into the circumferential chamber."

C-826-76
ICINGS ALONG THE TRANS-ALASKA PIPELINE ROUTE

Sloan, C. E., C. Zenone, and L. R. Mayo. 1975.
Open-file report 75-87. 39 p.

The location and extent of icings observed during the winters of 1969-1974 along the trans-Alaska pipeline route are shown on a series of maps and photographs. Construction of the pipeline, roads and corresponding structures will displace some icings and create new ones. Icings may cause problems such as flooding and erosion when they form on or near the pipeline or other facilities.

C-827-76
PIPELINE TRANSPORTATION OF LIQUID HYDROCARBONS

Steingraber, F. F., and M. U. Bagwell. 1975.
World Energy Conference, 9th, Detroit, 1974. New York, U.S.
National Committee of the World Energy Conference, 1975.
Vol. 6:357-369.

Improvements in pipeline technology, volumetric measuring device pumps, prime movers, and control and communication systems have resulted in improved safety, operating efficiency and reduced costs for transportation. The total effect on the environment i minimal.

Design and engineering

5. DESIGN AND ENGINEERING

C-828-76
LEVEL ALARM, CONTROL SYSTEM MADE TO PREVENT MANY SPILLS

Anon. 1975.
The Oil and Gas Journal 73(48):155.

A new electronic level alarm and control system has been developed to prevent spills from fuel or chemical storage. An internal circuit failure, damaged probe, fouled probe, connection break or internal power failure situation sounds the alarm. FFI contact Amiprodux Inc., Instrumentation Division, 150 W. 28th St., New York, New York 10001.

Oil transfer and transport

C-829-76
OFFSHORE PRODUCTION PRACTICES TO PROTECT THE ENVIRONMENT

Cole, D. E. 1975.
Petroleum and the Continental Shelf of North West Europe.
H. A. Cole (ed.). Barking, United Kingdom. Applied Science Publishers, 1975. Vol. 2. Environmental Protection. p. 23-27.

The oil industry continues to spend large amounts of money on developing the technology to prevent the accidental discharge of hydrocarbons from offshore wells and production facilities. The problems and equipment and technology designed to protect the environment are reviewed.

C-830-76
REFINERY DESIGN (CIRCA 1984)

Llovet, J. E., H. J. Klooster, and D. G. Chapel. 1975.
Chemical Engineering Progress 71(6):85-90.

This review gives the design strategy for a refinery with energy-conservation and environmental-protection objectives. Only proven refinery and related processes are incorporated into the design.

Waste treatment and disposal methods

6. WASTE TREATMENT AND DISPOSAL METHODS

C-831-76
TREATMENT OF WASTE WATERS CONTAINING EMULSIFIED OILS

Adachi, Y. 1975.
Japanese Kokai (unexamined patent application) 75,117,063

The waste waters are adjusted to pH 9-12 with $Ca(OH)_2$, mixed with flocculants, and aerated under pressure with stirring. The pressure is reduced (to atmospheric pressure) and the resulting floated oils are removed.

C-832-76
SLUDGE DEWATERING/DEHYDRATION RESULTS WITH MINI-B.E.S.T.

Ames, R. K., C. E. Van Valkenburg, and R. L. Olson. [1975?]
Purdue Industrial Waste Conference, 30th.[1975?] p. 2. Abstracts.

The Basic Extractive Sludge Treatment (BEST) system dewaters municipal and industrial sludges and produces 95% dry sterile solids, clear sterile water, and recoverable oils. Test results, using a sludge processing demonstration unit (mini-BEST) are presented and information for a projected pilot plant is discussed.

C-833-76
No title given (news brief)

Anon. 1976.
Environmental Science and Technology 10(1):14.

The petroleum industry spent more than $7.1 billion for environmental protection between the years 1966-1974; 58% was spent for air pollution, and 33% for water pollution control. The API president has warned that regulation compliance costs are increasing rapidly, diverting capital needed for exploration.

Economic effects of oil pollution

C-834-76
ASSAULT ON OIL POLLUTION BY TANKER WASTE CONTROL

Anon. 1975.
Marine Engineer's Review 5(May):25-26.

An oil and water separation system for shipboard use developed by the Keene Cooperation satisfies the stringent regulations of the

U.S. Coast Guard and EPA. The failsafe and monitoring systems ensure that the oil content of the effluent does not exceed 8 ppm. Automatic shutdowns and alarm systems are part of the unit. Technical details on the design, installation and operation of this system are given.

Design and engineering

C-835-76
BURNING OIL MUDS MAY SOLVE DISPOSAL PROBLEMS

Anon. 1976.
World Oil 182(1):109, 112-113.

In situ burning is shown to be an effective technique for the disposal of oil muds in offshore or inaccessible onshore locations. Tests using the Seadragon burner, manufactured by Flopetrol, showed that even oil muds with high percentages of water and drill solids could be burned completely, leaving only a residue of ash or charred solids.

C-836-76
BURNING USED LUBRICANTS IN PLANT BOILERS (news brief)

Anon. 1975.
Plant Engineering 29(6):54.

Used lubricants are pumped into a settling tank, water is drawn out at the bottom and the oil is pumped through an 840-micron filter. Petroleum products with flash points between 100° and 600° F can be added to this oil and burned in plant boilers. The mixture can be made of up to 25% used lubricant.

C-837-76
CLEANING OIL SPILLS ON "OLE MAN RIVER"

Anon. 1975.
Solid Wastes Management/Refuse Removal Journal 18(9):24-.

The presence of many refineries and petrochemical plants along the lower Mississippi River call for specialized equipment and contingency planning to handle oil spill emergencies such as the Vicksburg spill. The article describes facilities and treatment processes available to the Browning-Ferris Industries for handling routine toxic and oil wastes, and also discusses the company's past and projected handling of oil spill emergencies.

Contingency planning, Cleanup and recovery

C-838-76
ENVIRONMENTAL ACTION (news brief)

Anon. 1975.
Petroleum Engineer International 47(12):EM6.

A new technology for treating refinery and chemical waste water has been developed by Amoco Oil Company, Texas City refinery. The new plant is designed to process 23 million gallons of waste water/day; much of this is recycled, reducing the refinery fresh water demand.

C-839-76
INCINERATORS, ROTARY DRIERS AND ELECTROSTATIC PRECIPITATORS

Anon. 1976.
Industrial Wastes Information Bulletin 6(2):#HMS 5507.

"Details of electrostatic precipitators, rotary driers/roaster systems for sludges and spent liquids and rotary kiln incinerators for solid and liquid waste such as oils, sewage sludge, chemical wastes are given." FFI contact F. L. Smidth & Co. A/S, 77 Vigerslev Alle, DK-2500 Valby, Copenhagen, Denmark.

C-840-76
INDUSTRIAL WATER AND WASTE MATERIALS TREATMENT (product information)

Anon. 1975.
Industrial Wastes Informaton Bulletin 5(6):#HMS 5131.

Effluent treatment for chromate, phosphate, emulsions and foams is described. Details are also given on flocculants, algae, bacteria inhibitors and material to control corrosion and sludge build-up.

C-841-76
MARINE MUNICIPAL AND INDUSRIAL WASTERWATER [sic] DISPOSAL

Anon. [1975?]
International Congress, 3r. 415 p. Preprints.

The papers cover a broad range of topics, including the development of oily water separation systems for shipboard use; planning, design, and construction of sewage and industrial water disposal, and dispersal systems and related pollution control projects. Also covered are effects of waste water disposal and discharge upon coastal fish, invertebrates and phytobenthos, study methodology and evaluation of pollution data, and measurement of pollution in the sea.

Biological effects of oil pollution. Sampling, analysis

C-842-76
MET-PRO SERIES 7000 BELT OIL SKIMMER (product information)

Anon. 1975.
Industrial Wastes Information Bulletin 5(6):#HMS 5073.

A 24-inch wide continuously revolving belt is partially immersed in the oily process water. Floating oil adheres to the belt and is removed by rubber rollers. FFI contact Met-Pro Corporation, Fifth St. and Mitchell Ave., Lansdale, Pennsylvania 19446.

Design and engineering

C-843-76
NEW PRETREATMENT PROCESS REMOVES OIL FROM WATER (product information)

Anon. 1976.
The Oil and Gas Journal 74(3):73.

The pretreatment facility handles up to 50 gpm, in a continuous process that reduces oil content from 100,000 mg/l to less than 100 mg/l. The process is a combination of chemical treatment and dissolved air flotation. Complete data are available free from Eaton Corp., 100 Erieview Plaza, Cleveland, Ohio 44114.

C-844-76
OIL/WATER SEPARATION PROCESS (product information)

Anon. 1975.
Industrial Wastes Information Bulletin 5(6):#HMS 5042.

Oil droplest in effluents are coalesced by passing them through a novel open-pore filter medium. Oil rises to the surface and can be removed by a skimmer. FFI contact ICI Pollution Control Systems, GB-PO Box 15, Hyde, Cheshire SK14 4EJ.

C-845-76
OILY WATER SEPARATOR (product information)

Anon. 1976.
Offshore 36(1):147.

A marine discharge control system has been designed for small craft and workboats. Developed by Velcon Filters Inc., the PM-1300 series oily water separators purify bilge or other oily water discharge to within the acceptable clean water limits set by the U.S. Coast Guard.

Design and engineering

C-846-76
PURIFY OILY WATER DISCHARGE (product information)

Anon. 1976.
Ocean Industry 11(2):204, 206.

Velcon Filters Inc. manufactures oily water separator systems that are 100% effective in purifying oily water discharges. The units contain probes on the filter and coalescer stages that detect oil accumulation, whereupon it is automatically drained off. Oil is reduced to less than 10 ppm in the effluent.

Design and engineering

C-847-76
SEPARATOR TAKES OIL FROM WATER (product information)

Anon. 1976.
The Oil and Gas Journal 74(2):119.

The gravity differential separator can be used for waste water effluent as well as oil spill cleanup. Emulsions and suspended solids are separated by chemical treatment. The separators are self-contained units and the tanks are corrosion-proof and maintenance-free. FFI contact AFL Industries, 1149 Howard Drive, W. Chicago, Illinois 60185.

Cleanup and recovery

C-848-76
SKIM OIL-WATER SEPARATOR (product information)

Anon.
Klein, A., Meent 3b, Rotterdam, P.O.B. 1659, The Netherlands
(agent for Hellevolt B.V.)

Hellevolt B.V. of Hellevoltsluis, The Netherlands, manufactures a skim oil-water separator that has been mainly used for the treatment of ballast water at oil terminals. Water and oil are separated between curved and horizontally-inclined steel plates. After treatment, ships' ballast water has less than 10 ppm oil. The separator can also be used on offshore platforms and in refineries.

Design and engineering

C-849-76
TRANSLATIONS ON ENVIRONMENTAL QUALITY

Anon. 1974.
Joint Publications Research Service, JPRS 62033. 36 p.

Of the 13 articles and 3 news briefs, one article from the USSR documents the improvement of the Krasnovodsk Oil Refinery waste treatment facilities. The article from West Germany concerns testing ideas for combating environmental pollution.

Design and engineering

C-850-76
UNIT SEPARATES OIL AND SLUDGE FROM INDUSTRIAL WASTEWATER

Anon. 1975.
Water and Pollution Control 113(5):21-22.

CPS, corrugated plate separators, have been developed for the petroleum industry. CPS systems contain 1 or more CPI (corrugated plate interceptor) platepack units mounted in basins having inlet and outlet weirs, appropriate nozzles, and sand or sludge compartments. CPS modules can be connected in parallel to achieve the desired flow capacity. Operation details are given.

Design and engineering

C-851-76
WASTE COLLECTION AND DISPOSAL SERVICES (product information)

Anon. 1976.
Industrial Wastes Information Bulletin 6(3):#HMS 5805.

Services include tank cleaning, oil and chemical disposal, gully cleansing, farm waste disposal and steel fabrication. FFI contact Cleansing Service Group, Botley, Southampton SO3 2HD.

C-852-76
PORT RECEPTION AND TREATMENT FACILITIES FOR OILY WASTE FROM VESSELS

Armstrong, A. S., and K. J. Randall. 1974.
International Conference on Waste Oil Recovery and Reuse, Washington, D.C., 1974. Washington, D.C., Information Transfer, Inc. p. 169-184.

The various methods for removing oily waste from vessels in U.S. ports and disposing of the treated water and recovered oil are described. The economic feasibility of waste oil recovery/disposal operations from vessels, and the roles of government agencies in preparing for shoreside handling of vessel-generated oily wastes are discussed.

C-853-76

RECOVERING THE OIL CONTENT OF WASTE OIL EMULSIONS, PARTICULARLY MACHINING COOLANTS

Atherton, D. G., and B. A. Silvester. 1975.
German Offenlegungsschriften (unexamined patent application) 2,425,009

Phase separation and recovery of oil from waste oil emulsions is facilitated by adding metal salts (Group II) and trivalent metal salts in a mole ratio of (5-15):1, after the pH is adjusted to less than 7. The optimal combination of salts is $CaCl_2$ and $Fe_2(SO_4)_3$.

C-854-76

PROCESS OF USING A MICROBIAL DEGRADATION FACILITY

Azarowicz, E. N. 1975.
U.S. Patent 3,899,376

In this facility, effluent containing petroleum and oily wastes is introduced into the initial degradation system together with microorganisms and nutrients. Degradation proceeds with aeration or stirring. The partially degraded effluent is conveyed to the final degradation system where additional microorganisms are added. The resulting effluent is filtered and may be discharged safely into the environment.

Biological degradation

C-855-76

CRUDE OIL LOSSES AND POLLUTION, TANKER INERTING AND CLEANSING, HUMAN SAFETY, AND FLUOROSOLVENTS

Brauer, M. M. 1975.
Dissertation Abstracts International, B 36(6):2962-B - 2963-B.

The system uses a single waterless fluorinated hydrocarbon inerting/cleansing agent in a continuous stream, closed-loop setup in an integrated single-point-mooring configuration. The system reduces hazard levels from toxicity, explosion and asphyxiation and reduces the cost due to tankers being forced to go miles offshore to dump and flush oily wastes.

Oil transfer and transport

C-856-76
POLLUTION PROBLEMS FROM A WATER ENGINEER'S POINT OF VIEW

Burt, D. 1975.
Externer Bericht, Kernforschungszentrum Karlsruhe 4(3):172-174.

The means available to a water engineer for controlling effluent parameters such as temperature, viscosity, flow, specific gravity, droplet size and degree of pollution are discussed. The merits of two systems, the parallel plate and the American petroleum industry gravity systems, for separating various toxins from water, are also discussed.

C-857-76
WASTE LUBRICATING OIL CHARACTERISTICS--DO THEY VARY GEOGRAPHICALLY, SEASONALLY, AND WITH ORIGIN

Carter, R. C. 1974.
International Conference on Waste Oil Recovery and Reuse, Washington, D.C., 1974. Washington, D.C., Information Transfer, Inc. p. 73-90.

A two-phase project conducted by the American Petroleum Institute deals first with the study of waste lubricating oil characteristics to determine how to make economic use of these oils. The second phase consists of burning tests to demonstrate the feasibility of burning small ratios of waste fuel oil blends without significant impacts on the environment.

Reclamation and reuse

C-858-76
SHIPYARD PROBLEMS WITH OILY WASTES

Clark, A. C. K. 1974.
International Conference on Waste Oil Recovery and Reuse, Washington, D.C., 1974. Washington, D.C., Information Transfer, Inc. p. 201-205.

Current regulations limit the amount of oily water released to a harbor and the amount of harmful emissions from the burning of fuels. Equipment to reduce residual oil in oily wastes to such low levels is not currently available; therefore, alternate slop disposal methods for shipyards must be found. Port authorities should control disposal facilities,as individual facilities for each shipyard are not economically feasible.

U.S. legislation

C-859-76
BIODISK IMPROVES EFFLUENT-WATER-TREATING OPERATION

Congram, G. E. 1976.
The Oil and Gas Journal 74(8):126-132.

As a result of new discharge standards which dictated a need for improved methods of refinery pollution control, Chevron Oil's Salt Lake City refinery became the first domestic or foreign plant to select the biodisk effluent-treating method. The performance of the biodisk has been satisfactory. Its operation and efficiency at the Salt Lake refinery are discussed.

Design and engineering

C-860-76
MASSACHUSETTS WASTE OIL MANAGEMENT ACTIVITIES

Corey, D. L. 1974.
International Conference on Waste Oil Recovery and Reuse, Washington, D.C., 1974. Washington, D.C., Information Transfer, Inc. p. 309-325.

The waste oil disposal problem in Massachusetts and the responsibility of the Massachusetts Division of Water Pollution Control for aspects of waste oil handling are discussed. Sources of waste oils are listed. Due to economic disincentives, i.e., labelling and excise tax rulings, re-refining of lube oil is no longer practiced in New England. Research and development programs for oil production control and waste oil disposal are mentioned.

C-861-76
COALESCING DISPERSED DROPLETS

Davies, G. A., and G. V. Jeffreys. 1975.
British Patent 1,409,045

Coalescence of a dispersed phase of an emulsion takes place in a column packed with intermeshed high- and low-surface-energy, woven, knitted or other meshed fabrics.

C-862-76
SCIENTIFIC PRINCIPLES OF THE CONTROL OF WATER POLLUTION

Dickinson, D. 1974.
Practical Waste Treatment and Disposal. D. Dickinson (ed.). New York, N.Y., Wiley, 1975. p. 1-12.

Principles of water pollution control, classes of polluting effluents, toxic substances, discharges to estuaries, and influence of climatic conditions are reviewed.

Source identification

C-863-76

PROTECTION OF AQUIFERS AGAINST PETROLEUM POLLUTION IN SWITZERLAND

Dracos, Th. 1974.
Groundwater Pollution in Europe. J. A. Cole (ed.). Conference of the Water Research Association, Reading, England, 1972.
p. 310-327.

Two examples of protection of aquifers against contamination are cited. Near Dietikon-Kilwangen, a compacted delaying layer under the ballast has been set up to allow the contaminated soil materials to be dredged before oil reaches the groundwater. At a refinery a system of wells forms a depression of the groundwater table toward the center of the refinery area. This prevents contaminated groundwater from flowing out of this area.

C-864-76

PROPOSAL FOR A COUNCIL DIRECTIVE ON THE DISPOSAL OF WASTE OILS

E.E.C. 1974.
Official Journal of the European Communities, No. C64. p. 5-7.

The proposal provides for the environmental regulation of the treatment, discharge, deposit and collection of waste oils. Waste oil recovery is encouraged. The directive was to be enforced by December, 1975.

Reclamation and reuse, International legislation

C-865-76

APPARATUS FOR SEPARATING ON THE SEABED EFFLUENTS FROM UNDERWATER OIL WELLS

Entreprise de Recherches et d'Activites Petrolieres. 1975.
British Patent 1,420,167

The apparatus consists of a concrete base on the sea floor with an attached caisson linked by pipes to the different oil wells.

The caisson is divided into two compartments with a burner connected to each. Oil from the wells enters the main compartment and passes to a monitor compartment. Pressure in the compartments is valve-controlled, and the amount of gas burned off is metered. Gas-free liquid hydrocarbons are pumped to a floating store.

C-866-76
NOTES ON THE DISPOSAL OF TOXIC SOLID WASTES

Essex Water Co. (England). 1974.
Groundwater Pollution Europe. J. A. Cole (ed.). Conference of the Water Research Association, Reading, England, 1972. p. 23-24.

Concern about the dumping of solid wastes, petroleum, metallic and gypsum wastes has been expressed by the Essex Water Company. The greatest hazard may be semi-solid oily wastes or tar wastes from garages and in refuse dumps. River pollution by accidental spillage of oil is a recurrent problem.

C-867-76
PETROLEUM REFINERY LIQUID WASTES: ENVIRONMENTAL, ENERGY AND ECONOMIC IMPACTS

Finelt, S. 1975.
Ph.D. Thesis, Houston University. 642 p.

Detailed simulation models for liquid waste generation and treatment were derived from an analysis of a petroleum refinery operation. From these models the economic incentives for refinery water reuse and for producing environmentally acceptable effluent can be assessed.

Economic effects of oil prospecting and production

C-868-76
COMPOSITIONS FOR THE REMOVAL OF HYDROCARBON AND INDUSTRIAL WASTE BY BIOLOGICAL DEGRADATION

Fusey, P. 1974.
U.S. Patent 3,796,637

Hydrocarbons are degraded by adsorption on a mineral (i.e., talc), aided by oleophilic substances; and by addition of metal oxide or alkali metals peroxide, which promotes aerobic conditions; and nutrients.

Cleanup and recovery, Biological degradation

C-869-76
SEPARATING MIXTURES OF OIL AND WATER

Geurtsen, A. A. 1975.
German Offenlegungsschriften (unexamined patent application)
2,455,904

The separation apparatus consists of an upper movable bell jar and a bottom filter. Both sections have inlets and outlets. The filter removes sludge from the water. When enough oil accumulates in the bell jar, the outlet valve opens and the oil is removed.

Design and engineering

C-870-76
OIL REMOVAL BY CARBON-METAL GRANULAR BEDS

Ghosh, M. M., and W. P. Brown. 1975.
Journal, Water Pollution Control Federation 47(8):2101-2113.

A new process for removing oil from dilute aqueous emulsions, such as industrial wastes, was investigated. Two dissimilar metals, in contact and submerged in a conducting medium, form an electrochemical cell. Oil droplets migrate to the positively charged areas. The oil droplets aggregate and are trapped within a porous bed. Factors influencing efficiency are examined.

C-871-76
ISOLATION OF NAPHTHENIC ACIDS

Goryaeva, E. M., V. I. Kodovbetskaya, S. A. Zhanaidarova. 1975.
U.S.S.R. Patent 481,594

The alkaline wastes of petroleum refining can be treated to remove naphthenic acid. The wastes are extracted, then the emulsion is broken by standing at 40-70° and acidifying. This method is improved and the fire hazard reduced by extracting with $C_2H_4Cl_2$.

C-872-76
USE GRAVITY BELT FILTRATION FOR SLUDGE DISPOSAL

Grove, G. W. 1975.
Hydrocarbon Processing 54(5):82-84.

Refinery and petrochemical wastewaters can be concentrated by the use of gravity belt filtration, which is the second step in a three-step process that concentrates and disposes of oily solids. The advantages of gravity belt filtration over other mechanical dewatering techniques are explained. The techniques available for ultimate disposal are compared.

C-873-76
POLLUTION CONTROL WITH A COMPREHENSIVE WASTE OIL PROCESSING PLANT

Gumtz, G. D. 1974.
International Conference on Waste Oil Recovery and Reuse, Washington, D.C., 1974. Washington, D.C., Information Transfer, Inc. p. 261-279.

The design needs of a plant for the reuse or disposal of waste oils generated in Maryland are considered. A single processing facility was postulated which has the potential to treat all the waste oils generated on a statewide basis. Processes selected to be included in the facility are given.

Reclamation and reuse

C-874-76
TEMPERATURE-TOXICITY MODEL FOR OIL REFINERY WASTE-DISCUSSION

Haas, C. N. 1975.
Journal of the Environmental Engineering Division, ASCE 101(EE3): 446-447.

The author discusses a paper of the same title by J. H. Reynolds, E. J. Middlebrooks, and D. B. Porcella. The assumption that Scenedesmus toxicity levels are similar to Selanastrum toxicity thresholds is questioned. The author also doubts if phenol-caused competitive inhibition has been proven. Heavy metal toxicity may be equally important.

C-875-76
ELECTROLYTIC TREATMENT OF WASTE WATERS CONTAINING EMULSIFIED OILS

Hayashi, T. 1975.
Japanese Kokai (unexamined patent application) 75,127,449

The waste waters are adjusted to an acidic pH and electrolyzed by using Al-Al electrodes. The oil is emulsified by the Al which dissolves in the water.

C-876-76
POTENTIAL POLLUTANTS FROM PETROCHEMICAL PROCESSES

Hedley, W. H., S. M. Mehta, C. M. Moscowitz, R. B. Reznik,
G. A. Richardson, and D. L. Zanders. 1975.
Westport, Connecticut, Technomic Publishing Company, 1975. 383 p.

This book identifies and discusses the 11 basic raw hydrocarbon materials used in the majority of synthetic organic products, and describes the 7 major industries which use these materials and/or their derivatives. Detailed descriptions and flow diagrams showing production procedures and resultant waste materials are presented for each industry.

General effects of oil prospecting and production

C-877-76
CARGO/BALLAST SEPARATION BY DUAL MEMBRANE SYSTEM

Hering, F. S., and J. I. Schwartz. 1974.
PAT-CL-114-74-R. 12 p. [PAT-APPL-452 082/GA]

Flexible or stretchable membranes are attached in a liquid sealing relationship within the oil tank to prevent the oil and ballast water from mixing. The entire tank can be kept full in order to maintain ship stability, while oil pollution from deballasting of ships is prevented.

Oil transfer and transport

C-878-76
SEPARATION OF OIL FROM WASTE WATER CONTAINING EMULSIFIED OIL

Honda, S. 1975.
Japanese Kokai (unexamined patent application) 75 58,861

Electrolytes (Ca^{++} or Mg^{++}) can be used as salting-out agents in removing emulsified oil from waste water. For example, 5000 ppm $CaCl_2$ was added to an oil-water emulsion and the pH adjusted to 6. After vigorous stirring, the solution was left standing for 60 min. More than 99.9% of the oil was separated from the water as an upper layer.

C-879-76
TREATMENT OF WASTE OIL/WATER EMULSIONS BY MEMBRANE TECHNIQUES

Horton, S. 1975.
Externer Bericht, Kernforschungszentrum Karlsruhe 4(3):179-189.

Membrane techniques can be used to solve the problem of oily wastes, producing an oil concentrate and an effluent that can be reused or discharged. The present state-of-the-art in membrane separation technology is reviewed; process parameters influencing the flux rate and membrane retention efficiencies are discussed.

C-880-76
TREATMENT OF WASTE WATERS CONTAINING MINERAL OILS

Hoshika, K., M. Yasuda, H. Goto, and K. Sakurai. 1975.
Japanese Kokai (unexamined patent application) 75 94,759

Waste water containing emulsified mineral oils is first treated with sludge and a flocculant, then the floc is removed. The remainder is treated by a conventional activated-sludge process. The oil concentration is reduced from 270 ppm to 4 ppm.

C-881-76
USE OF OZONE IN TREATING REFINERY WASTES

Ioakimis, E. G., A. E. Kulikov, V. I. Nazarov, and N. M. Podgoretskaya. 1975.
Chemistry and Technology of Fuels and Oils 11(3-4):188-192.

These studies showed that the most effective method of ozonation is multistage contact of the reaction gas with the waste streams. The maximum reduction in contamination (based on COD) is 60%. The formation of intermediate products through the interaction of ozone with the initial "contaminant" was confirmed.

C-882-76
OILY CLAY WASTE TREATMENT

Ishihara, K., and N. Izumi. 1975.
Japanese Kokai (unexamined patent application) 75 86,477

Both the edible oil and fat processing and petroleum refining industries produce oil containing clay wastes. These wastes are pelletized to increase the burning efficiency, and then burned.

C-883-76
THE WASTE OIL INDUSTRY: A DISCUSSION OF SOME ISSUES TO CONSIDER IN PERFORMING AN ECONOMIC ANALYSIS

Jaksch, J. A. 1974.
International Conference on Waste Oil Recovery and Reuse, Washington, D.C., 1974. Washington, D.C., Information Transfer, Inc. p. 395-404.

The analysis of the waste oil industry from an economic point of view is reviewed. Waste oil disposal, collection and refining are considered. Cost-effective and environmentally-effective options include: paying subsidies to recover waste oil; changing current tax laws which encourage use of virgin oil over recovered oil; or specification of federal oil waste recovery policies.

Reclamation and reuse

C-884-76
ACCELERATION OF BIOCHEMICAL TREATMENT OF WASTE WATER IN PETROLEUM REFINERIES

Karelin, Ya. A., D. D. Zhukov, I. A. Saidaminov, O. N. Klochkov, and M. A. Denisov. 1975.
International Chemical Engineering 15(3):560-562. (Translated from Nefte Pererabotka i Neftekhimiya 1974(9))

The two stage biochemical treatment system contains a pressurized flotation unit as the first stage. This unit rapidly separates high concentration sludge mixtures and returns highly concentrated sludge to the aeration zone. This process increases oxidation capacity and the degree of sludge thickening, and decreases sludge depuration time.

C-885-76
SURFACE CHEMISTRY PARAMETERS IN ECOLOGICAL CLEANUP OF OILY WASTEWATER

Kaufman, S. 1976.
Environmental Science & Technology 10(2):168-173.

The current technology employed to remove oil from ship bilge water is examined. Six solid substrates, five typical oils, seawater, distilled water and military and nonspecification detergent formulations were studied in various combinations. Glass and resinous binders were the least effective substrates for separation; polypropylene and polytetrafluoroethylene were the most effective. The nonspecification cleaner showed the most promise of the three detergent formulations.

C-886-76
THE NAVY'S OILY WASTES HANDLING AND DISPOSAL PROGRAM

Kinney, E. T., and M. G. Grant. 1974.
International Conference on Waste Oil Recovery and Reuse,
Washington, D.C., 1974. Washington, D.C., Information Transfer,
Inc. p. 133-147.

The Navy's oily wastes handling and disposal program is reviewed. To handle the variety of oil wastes produced, treatment facilities require a total system concept including collection, transportation, storage and treatment/disposal. Corrective actions for wastes from naval ships are given.

C-887-76
REMOVAL OF OILS FROM WASTE WATER

Kobayashi, A., M. Kumazawa, and K. Tsuda. 1975.
Japanese Kokai (unexamined patent application) 75 74,571

Foam polyolefin resins are used to pack a filter bed which adsorbs oil from waste water that has been pretreated, either by gravity separation or sand filtration. The oil concentration is reduced from 1.4 ppm to 0.8 ppm, at a rate of 50 tons of waste water/hour.

Design and engineering

C-888-76
DISPOSAL AND/OR RECYCLE OF AIR FORCE WASTE PETROLEUM OILS AND LUBRICANTS

Kroop, R. H., and M. Lieberman. 1974.
International Conference on Waste Oil Recovery and Reuse,
Washington, D.C., 1974. Washington, D.C., Information Transfer,
Inc. p. 117-129.

Means for effectively disposing of or recycling Air Force waste petroleums, oils, and lubricants (POL) are discussed. Topics considered include generation of waste POL's at Air Force installations, collection and segregation of such wastes, disposal and recycle alternatives and the reprocessing of synthetic turbine lubricants.

Reclamation and reuse

C-889-76
PRIMARY-WASTE-TREATMENT METHODS

Lash, L. D., and E. G. Kominek. 1975.
Chemical Engineering 82(21):49-61.

Optimum treatment methods for the removal of dissolved solids, suspended solids, and oily matter from waste waters are evaluated. Treatment procedures should be based on the physical and chemical properties of the waste stream.

C-890-76
WASTE OIL MANAGEMENT - THE ENVIRONMENTAL PROTECTION AGENCY'S ROLE

Lederman, P. B., and K. Jakobson. 1974.
International Conference on Waste Oil Recovery and Reuse, Washington, D.C., 1974. Washington, D.C., Information Transfer, Inc. p. 19-27.

The programs funded by the EPA in waste oil management are discussed. Specific projects include the development of a non-polluting process for re-refining and recovering waste oils for use as diesel fuel or lubricants, acceptable means of disposing of re-refining sludges, and waste oil collection systems and models.

Reclamation and reuse

C-891-76
DEVELOPMENT OF OILY WATER SEPARATING SYSTEMS FOR SHIPBOARD USE

Lucas, R. S. 1975.
Marine Municipal and Industrial Wasterwater [sic] Disposal: International Congress, 3rd, 1975. p. XXI-1-XXI-14. Preprints.

This paper describes the design features and capabilities of oil-water separation systems used by the U.S. Coast Guard. These systems are comparatively small, inexpensive and lightweight and are capable of meeting U.S. national and international requirements. Oil pollution regulations and legal requirements for ships are also covered.

U.S. legislation, International legislation

C-892-76
ENERGY PRODUCTION AS A SOURCE OF WATER POLLUTION

Luken, R. A. 1975.
World Energy Conference, 9th, Detroit, 1974. New York, U.S. National Committee of the World Energy Conference, 1975. Vol. 3:414-435.

Current state-of-the-art processes used in the waste water treatment industry form the basis of the latest and best practicable control technology presently available in the petroleum industry.

C-893-76
CHEMICALS AND ALLIED PRODUCTS

Macauley, D. C. 1974.
Journal Water Pollution Control Federation 46(6):1337-1341.

The various control techniques available for industrial wastes, including wastes from refineries and petrochemical plants, are reviewed. The literature on adsorption, biological treatment, in-unit control, alum coagulation, beds of reactive metal particles, and ultimate disposal techniques is summarized.

C-894-76
TREATMENT OF WASTEWATER FORMED IN PRODUCTION OF SYNTHETIC LUBRICATING OIL, GRADE LNMZ-36/1

Makeikina, V. V., and O. V. Mamontova. 1975.
Chemistry and Technology of Fuels and Oils 11(3-4):185-187.

A waste water treatment plant built in a petroleum refinery in the Soviet Union and capable of producing lubricating oils is described. A flow chart, along with plant performance data, is included.

C-895-76
WASTE OIL: THE RECAPTURE OF AN ENERGY RESOURCE (THE GENERATION, DISPOSAL AND RECOVERY OF WASTE OIL IN THE NEW YORK METROPOLITAN AREA)

Maltezou, S. 1974.
International Conference on Waste Oil Recovery and Reuse, Washington, D.C., 1974. Washington, D.C., Information Center, Inc. p. 55-69.

Included among the topics of this study on waste oil assessment are: quantities of waste oil generated by type and location of users of oils; methods of disposal by users of oil; quantities of waste oil disposed of and cost of each disposal method; systems of collection, ways of reusing oil, and quantities of waste oil processed by re-refineries; and general trends in the disposal, recovery and reuse of waste oil.

Reclamation and reuse

C-896-76
BREAKING EMULSIONS

Markofsky, S. B. 1975.
U.S. Patent 3,900,423

A method for breaking oil-water and water-oil emulsions involves an aqueous emulsion of these types which is mixed with an aqueous solution of a demulsifier. The preparation of the demulsifier is described.

Cleanup and recovery

C-897-76
APPARATUS FOR RECOVERING THE OIL CONTENT OF WASTE SOLUBLE OIL EMULSION

Midland Oil Refineries Ltd. 1975.
British Patent 1,388,747

An emulsion is acidified, cracked with a phase separating agent, and the soluble and insoluble oils are separated by flotation. After precipitation of hydroxides the effluent can be discharged into a sewer.

C-898-76
DEEP WELL INJECTION OF LIQUID WASTE

Mokha, J. S. 1974.
Groundwater Pollution in Europe. J. A. Cole (ed.). Conference of the Water Research Association, Reading, England. p. 417-436.

The concept of deep well waste disposal is reviewed. Also included are sections on geological requirements and site selection, suitability of waste for injection, well design and development, surface equipment, injection monitoring, economics, and injection systems in use.

C-899-76
ADVANCED INDUSTRIAL WASTE TREATMENT PROCESSES FOR THE PETROLEUM REFINING/ORGANIC CHEMICAL INDUSTRY

Myers, L. H., and F. Mayhue. 1974.
AIChE Symposium Series, Water - 1973 70(136):568-576.

A review is given of several waste treatment processes used to remove inorganic and organic materials. In terms of costs and efficiencies, the active carbon treatment was selected as having the widest application.

C-900-76
DISPOSAL OF OIL WASTES BY MICROBIAL ASSIMILATION

Napier, J. M., and F. C. Francke. 1974.
AEC Environmental Protection Conference, 2nd, Albuquerque, New Mexico, 1974. p. 361-385.

A biological assimilation process for the disposal of plant oil wastes is described. Waste petroleum products are mixed with commercial fertilizers into the soil where naturally occurring microbial assimilation results in destruction of the oil wastes. Studies have shown that more than 30,000 gallons per year per acre of these wastes can be discarded in this way.

Biological degradation

C-901-76
FOAM SEPARATION--A TECHNIQUE FOR WATER POLLUTION ABATEMENT

Ng, K. S., and J. C. Mueller. 1975.
Water and Sewage Works 122(6):48, 52, 54-55.

The report describes in detail the techniques of foam fractionation and froth flotation. The latter technique is effective in the removal of suspended organic matter in aqueous solutions and can be applied to the recovery of oil from oil refinery wastes and sludge.

Reclamation and reuse, Design and engineering

C-902-76
SEPARATION OF OILS FROM WASTE WATER

Ohkita, J. 1975.
Japanese Kokai (unexamined patent application) 75 72,875

Gel permeation chromatography is used to separate and determine the components of oil in waste water. A mixture of mineral oil, waxes and triglycerides was separated on a column packed with Styragel by elution with triglycerides. Three distinct peaks were obtained.

C-903-76
REMOVAL OF OILS FROM WATER OR SEAWATER WITH SYNTHETIC RESIN

Ohkuma, I., and K. Suzuki. 1974.
Japanese Kokai (unexamined patent application) 74 111,883

Oils can be removed from water or seawater by spreading urethane foams, foamed plastics, or crushed polypropylene over the water.

For example, 10 gm of urethane agitated with seawater containing 50 gm of heavy oil removed all the oil. The urethane can be compressed to recover some of the oil.

Cleanup and recovery

C-904-76
TREATING PETROLEUM SLUDGE OILS AND WASTE OILS

Okuda, M. 1975.
Japanese Kokai (unexamined patent application) 75 10,303

The steps in treating an emulsified petroleum sludge oil include addition of the flocculant Na dialkylsulfosuccinate and treatment with a nonionic surfactant. When necessary, the emulsion is treated with an inorganic flocculant, and Na dialkylsulfosuccinate and inorganic and cationic flocculants are added to the separated water.

C-905-76
TREATMENT AND PURIFICATION OF WASTE WATER CONTAINING OIL

Oldham, G. F. 1975.
German Offenlegungsschriften (unexamined patent application) 2,461,727

The treatment of refinery waste water with <5 ppm oil consists of filtering the waste water through a sand filter and then through at least one biological trickling filter filled with plastic filter media. The sand filter can be regenerated with air and warm water. This water is placed in an oil separation tank.

C-906-76
REMOVAL OF OIL FROM WASTE WATER

Ono, H., and T. Saida. 1975.
Japanese Kokai (unexamined patent application) 75 27,765

A precondensate (made by reacting 100 g PhOH with 260 g 37% HCHO in the presence of 40 g 40% NaOH at 85° for 3 hr) was mixed with water containing heavy oil and ether. The pH was adjusted to 6, and the flocs were removed. Less than 1 ppm heavy oil remained.

C-907-76
OIL CONTAMINATED WATER RECYCLING SYSTEM

Overfield, J. L., and J. W. Richard. 1974.
International Conference on Waste Oil Recovery and Reuse, Washington, D.C., 1974. Washington, D.C., Information Transfer, Inc. p. 289-294.

The paper describes an oil-contaminated water recycling system which will reduce oil in contaminated water to 10 ppm and remove solids. Contaminated water is first sent into the filter/coalescer system, which removes solids. Water and oil pass into the tank unit where oil collects in an oil boot and water is expelled. The solids are backflushed to the solids cleaner where the oil is removed. Any remaining oily water is recycled through the system.

Design and engineering

C-908-76
INCINERATION OF INDUSTRIAL WASTE FLUIDS. CINCLUS PROCESS

Pariel, J. M. 1975.
Technique Moderne 67(3):29-33.

The Cinclus process is able to function by the combustion of a fuel-water emulsion. The process can be used to incinerate used oils unfit for recycling, oil emulsions, oil and water mixtures and hydrocarbon sludges. The advantages and the economics of the process, and an example of the process in use are discussed.

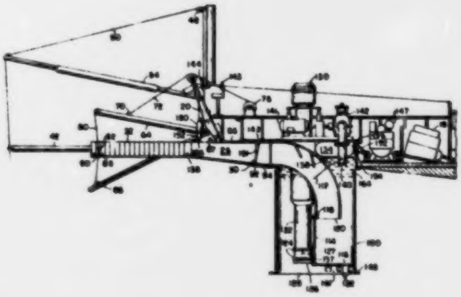
C-909-76
OIL/WATER SEPARATION AND RECOVERY SYSTEM

Pollution Recovery Systems. 1974.
U.S. Patent 3,815,751

A floating device channels fluids of different densities into a two-section separating tank. The higher density fluid is directed into the second section and is diverted over the wall into the first section. Means are provided for continuously removing the separated fluids.

Design and engineering

3,815,751
OIL/WATER SEPARATION AND RECOVERY SYSTEM
Jack D. Pavlovic, Oakland, Calif., assignor to Pollution Recovery Systems, Oakland, Calif.
Filed Oct. 6, 1971, Ser. No. 187,038
Int. Cl. E02b *15/04*
U.S. Cl. 210—242 **6 Claims**



C-910-76
DETERMINATION OF THE POSSIBILITY OF THE BIOLOGICAL TREATMENT OF WASTEWATERS GENERATED IN PETROLEUM REFINERIES. PART V. DEGRADATION OF NAPHTHENIC ACIDS AND SULFONIC ACIDS [English summary]

Pop, V. I., and S. I. Ionescu-Homoriceanu. 1975.
Revista de Chimie 26(3):241-243.

The biodegradation of residual waters from oil refineries by activated sludge in the presence of naphthenic and sulfonic acids was studied. Ninety-seven percent of the naphthenic acids were biodegraded after six hours treatment with a biological sludge adapted to this constituent. The sulfonic acids reduced the oxygen transfer and were only partially degraded, thus increasing the oxygen demand of the treated effluent.

C-911-76
PERSISTENT ORGANICS

Portmann, J. E. 1975?
Marine Municipal and Industrial Wasterwater [sic] Disposal: International Congress, 3rd, 1975. p. VI-1-VI-38. Preprints.

This report identifies several persistent organic chemicals in municipal and industrial waste water and discusses their sources and control. Methods to alleviate or prevent detrimental effects of such substances on the marine environment are examined. Present controls and the need for future controls at national and international levels are briefly discussed.

International legislation, General effects of oil pollution

C-912-76
MIXTURE FOR ACCELERATING THE BIODEGRADATION OF HYDROCARBONS FROM MINERAL OIL PRODUCTS

Potratz, E. 1975.
German Offenlegungsschriften (unexamined patent application) 2,365,170

The mixture, produced by reacting lignosulfate with a rare earth salt, accelerates the decomposition of oily wastes to compost useful for gardening.

Biological degradation

C-913-76
BODIES WITH LARGE SPECIFIC SURFACES

Proc, C. 1975.
German Offenlegungsschriften (unexamined patent application)
2,357,632

The material can be used in waste water treatment, and for removal of hydrocarbons from water. Two sheets of polyethylene make up the material; one of the sheets has convex half-bubbles. As they are absorbed, hydrocarbons swell the bubbles. The bubbles can be intact or pierced.

Cleanup and recovery

C-914-76
VERFAHREN UND ANLAGEN ZUR BEHANDLUNG VERBRAUCHTER OEL-EMULSIONEN
[English summary]

Rueb, R. 1975.
Wasser, Luft und Betrieb 19(7):415-419.

Many companies must contend with the problem of purifying used oil emulsions. The oil and water must be separated and the resulting effluent must not contain more than the limit of oil. The various methods and equipment used for this treatment are discussed.

C-915-76
OIL COLLECTOR

Segawa, H., Y. Hirano, and Y. Ueda. 1975
Japanese Kokai (unexamined patent application) 75 29,478

Nonwoven fabrics (density 0.02-0.15 g/cm^3) made from fibers consisting of 5-50 wt. % polyolefin and 50-95 wt. % polystyrene containing oil-soluble hydrophilic materials are used to remove oils from waste water.

C-916-76
WATER BUDGET FOR A REFINERY

Siebert, M. 1975.
Umwelthygiene 1(7):189-191.

The water budget and water cycle of the Mobil Oil Refinery at Woerth, West Germany, are described. Oil-free waste waters, such as storm water, are treated mechanically while oily waste waters are treated in a mechanical oil separator and the emulsion is subsequently broken in an aerated flotator.

C-917-76
DISPOSAL OF USED CRANKCASE AND OTHER OILS IN CANADA

Skinner, D. J., and P. L. Strigner. 1974.
International Conference on Waste Oil Recovery and Reuse,
Washington, D.C., 1974. Washington, D.C., Information Transfer,
Inc. p. 29-41.

The waste oil problem in Canada and the formation of the Petroleum Association for conservation of the Canadian Government are described. A variety of storage/collection and disposal techniques is in operation. Government and the petroleum industry are showing an increased interest in waste oil disposal, due to antipollution pressures and the energy shortage.

C-918-76
REPORT OF CONCAWE

Stichting CONCAWE. 1974.

A Concawe Special Task Force has concluded that incineration of refinery oily sludges is feasible. Concawe will try to compile a list of companies who can incinerate oily sludge on a contract basis. Guidelines for on-site incineration are given. Incineration is expensive and needs much attention; recovery of oil from such sludges is well worthwhile.

Reclamation and reuse

C-919-76
THE TREATMENT OF WASTEWATERS FROM PETROLEUM BARGE CLEANUP FACILITIES

Stryker, C. A., and J. E. Ball. 1975?
Purdue Industrial Waste Conference, 30th, 1975? p. 1. Abstracts.

A field and laboratory study was conducted on the problems associated with handling and treating washwater from petroleum barges. The waste waters are similar to those from a combined refinery and petrochemical plant and presented difficulties in processing because of the high salinity of bilge waters, batch flow characteristics of the waste, and variation in other waste water parameters.

C-920-76
PROCESS FOR ELIMINATING ORGANIC IMPURITIES FROM A STREAM OF FLUID

Sutherland, G. 1973 (filed).
Belgian Patent 806,698

This process uses a dispersed complex of activated charcoal and magnetic iron to remove organic impurities from liquid (or gaseous) effluent. The activated charcoal-iron complex first adsorbs the impurities, then a magnetic filter separates out the organically enriched complex from the purified fluid. The complex can then be recycled by heating in an inert atmosphere until the organic materials are vaporized.

C-921-76
TREATMENT OF WASTE WATERS CONTAINING EMULSIFIED OILS

Takahashi, H., A. Nakamura, and Y. Shibahara. 1975.
Japanese Kokai (unexamined patent application) 75 55,584

Waste waters containing emulsified oils are demulsified by the addition of water-soluble, vinyl-type high molecular weight compounds and water-soluble polyvalent metallic compounds.

C-922-76
OIL-ABSORBING POLYMERS

Takeda, N., and H. Maki. 1975.
Japanese Kokai (unexamined patent application) 75 94,092

Oil-absorbing materials are prepared by partially polymerizing homopolymers formed from vinyl monomers at 30-70° with a 0.001-0.5% crosslinking comonomer. The mixture is then polymerized further at a temperature 10-40° higher than that of the first step.

Cleanup and recovery

C-923-76
POLLUTION ABATEMENT PROCESS FOR REFINERY WASTEWATER

Texaco Development Co. 1975.
British Patent 1,399,426

In this process effluent mixed with a hydrocarbonaceous fuel is partially oxidized in a synthesis gas generator at ~800-1900°C. The technique is effective for removing sulfides, ammonia and phenols.

C-924-76
HOW TO DESIGN ACTIVATED SLUDGE UNITS

Thomson, S. J. 1975.
Hydrocarbon Processing 54(8):99-102.

The design procedure for an activated sludge unit for treatment of refinery and petrochemical plant effluents is illustrated.

Factors in the design include residence time, sludge production, sludge age, oxygen and nutrient requirements, and temperature. A sample problem in design demonstrates the interpretation of the data on these factors.

Design and engineering

C-925-76

ADSORPTION ON GRANULAR ACTIVATED CARBON APPLIED TO REFINERY WASTE WATER

Thorp, G. W. 1975.
Externer Bericht, Kernforschungszentrum, Karlsruhe 4(3):139-147.

Dissolved organic materials in the waste waters of the refinery industry can be either biodegradable or nonbiodegradable. They can be adsorbed on activated carbon. The basic principles of this adsorption and available system design techniques are discussed. An actual case study is presented.

Design and engineering

C-926-76

PROCESS FOR REMOVING HYDROCARBONS AND OTHER ORGANIC PRODUCTS FROM AQUEOUS FLUIDS

Tribellini, A. 1975.
U.S. Patent 3,905,901

The effluent to be treated is mixed with a hydrocarbon solvent insoluble in water. When passed through a bed of the solid adsorbent, the solvent containing dissolved hydrocarbons and other organic products is separated from the effluent.

3,905,901
PROCESS FOR REMOVING HYDROCARBONS AND OTHER ORGANIC PRODUCTS FROM AQUEOUS FLUIDS
Aldo Tribellini, St-Chamond, France, assignor to Creusot-Loire, Paris, France
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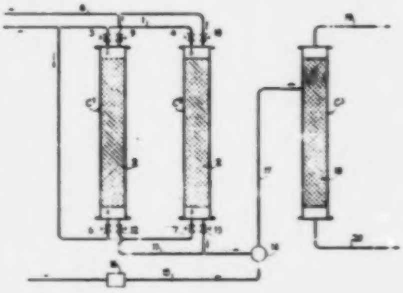
U.S. Cl. 210—21 **10 Claims**



C-927-76
CONTROL OF POLLUTION FROM PETROLEUM REFINERIES

Tuli, J. M., and S. B. Sheth. 1975.
Indian Chemical Journal 10(2):XXII-XXIX.

Sources of water and atmospheric pollutants and their control are discussed.

C-928-76
TREATMENT OF WASTE WATER CONTAINING OILS

Ueda, Y., H. Segawa, and J. Ohkita. 1975.
Japanese Kokai (unexamined patent application) 75 45,777

This method effectively treats waste waters containing dispersed oils by dripping the oil dispersion through a cylinder packed with oil adsorbent, such as polymers, at a rate which prevents its accumulation within the cylinder in the presence of air.

C-929-76
FLOCCULENTS FOR WASTE WATER TREATMENT

Umemura, K. 1975.
Japanese Kokai (unexamined patent application) 75 91,159

The flocculents are prepared from metallic salt flocculents and modified clays produced by reacting clays having base-exchange properties with amines and/or organic ammonium salts. Alkaline compounds may be added. The metallic salts improve the reaction of organic pollutants (i.e. oil) with the clay by improving the hydrophilicity of the modified clay.

C-930-76
OIL EMULSION WASTE-WATER TREATMENT

Unno, S. 1975.
Japanese Kokai (unexamined patent application) 75 14,143

A treatment for waste waters from gasoline stations and factories consists of adding water-insoluble organic solvents, then passing the waste waters through absorbent layers. A 16.1 ppm oil emulsion waste water was mixed with hexane, stirred and allowed to stand to separate the water and hexane phases. After passing through an absorbent column, the water was colorless and contained 0.4 ppm oil.

C-931-76
INSTALLATION OF OIL-TRAP AT NANTES-CHEVIRE POWER STATION

Viler, L., and M. Ricard. 1974.
La Technique Moderne 66(10):52-58.

The device described retains oil leaked into the waste discharge circuit to the river Loire. The installation consists of a decanting basin, an overflow chamber connected to the discharge main, and a storage compartment to receive the oil from the decantation process.

C-932-76
OILY BILGE FROM COMMERCIAL VESSELS

Waller, R. 1974.
International Conference on Waste Oil Recovery and Reuse, Washington, D.C., 1974. Washington, D.C., Information Transfer, Inc. p. 185-199.

Seaway Port Authority of Duluth, Minnesota, has been given a grant to characterize the sewage, bilge, ballast, dunnage and garbage from the vessels that enter Duluth Harbor. Based on samples of marine wastes, the oil content and total volume of bilge waters vary considerably between vessels. Waste oil re-refiners expecting to handle bilge waters must be prepared to accept variable conditions.

Reclamation and reuse

C-933-76
THE ADAPTATION OF THE CENTRIFUGE TO THE PROCESSING OF INDUSTRIAL EFFLUENTS

Woolcock, R. J. 1975.
Filtration and Separation 12(2):174-176, 178-180.

Discussed is the operation of the scroll discharge decanter centrifuge in terms of relation to sigma theory and operating parameters. Effluents from paper mills, pharmaceutical factories and petroleum refineries are among the applications.

Design and engineering

C-934-76
OIL EMULSION WASTE WATER TREATMENT

Yano, S. 1975.
Japanese Kokai (unexamined patent application) 75 47,452

Oils are separated from petroleum emulsion waste waters by adding $Ca(OH)_2$ at pH 6-10, aerating, and adding $Al_2(SO_4)_3$. The pH is then adjusted to 7.5 to 8.0, and the mixture is allowed to stand. Scum, water and precipitate are separated.

C-935-76
USAGE OF FROTH FORMED DURING WASTE-WATER TREATMENT

Yoshida, H. 1975.
Japanese Kokai (unexamined patent application) 75 96,054

After waste water is treated with flocculants and the major part of the froth dissolved, the residual insoluble froth can be removed. This insoluble fraction contains a large amount of oil. The high oil content makes further treatment such as burning simpler. Care should be taken not to add excess acid or alkaline which will dissolve this residual froth.

7. RECLAMATION AND REUSE

C-936-76
HOW AND WHY CENTURY HAS MOVED INTO RECYCLING OIL

Anon. 1975.
Materials Reclamation Weekly 126(35):16-17.

A plant for refining used lubricating oils has been proposed for Dartford. A high grade recycled product is being produced by the pilot scheme and has been tested successfully by a Century-sponsored racing team.

C-937-76
INTERNATIONAL CONFERENCE ON WASTE OIL RECOVERY AND REUSE, WASHINGTON, D.C., 1974

Anon. 1974.
Washington, D.C., Information Transfer, Inc., 1974. 418 p.

Papers are presented on the technical, institutional and economic aspects of spent and waste oil recovery. The feasibility of reusing waste oil as a fuel, as well as institutional problems and detrimental aspects, is considered.

C-938-76
OIL: IT NEVER WEARS OUT, JUST GETS DIRTY

Anon. 1974.
Environmental Science and Technology 8(4):310-311.

The main points of the 1st International Conference on Waste Oil Recovery and Reuse are reviewed. The general feeling was one of concern with the problem of discarded waste oils. Some recent developments in rerefining technology are briefly discussed.

Waste treatment and disposal methods

C-939-76
OREGON TRACES FLOW OF HAZARDOUS MATERIALS

Anon. 1975.
Solid Wastes Management/Refuse Removal Journal 18(3):48-51.

The hazardous materials produced in Oregon are removed in different ways. Oil can be collected for re-refining, road oiling, for use as heating fuel, etc. About 8 million gallons a year of automotive lubricating oil are recovered. The alternatives to landfill for toxic wastes include recovery, recycling and neutralizing the toxic effect.

Waste treatment and disposal methods

C-940-76
USED OILS AS SOURCES OF RAW MATERIALS AND OF ENERGY [English summary]

Audibert, R., and P. Trambouze. 1975.
Informations Chimie (145):119-120, 123-127.

Used motor oil can be burned together with standard fuel oil in conventional burners when added in small amounts. When used motor oil is going to be used to produce new oil, mechanical impurities must be removed by filtration and water and lightweight hydrocarbons eliminated. Treatments to remove suspended solids and soluble oxidized compounds are necessary. The energy expended to recover used oil is lower than that required for the initial production.

Waste treatment and disposal methods

C-941-76
WASTE AUTOMOTIVE LUBRICATING OIL AS A MUNICIPAL INCINERATOR FUEL

Chansky, S., B. McCoy, N. Surprenant, and J. Sahagian. 1974.
International Conference on Waste Oil Recovery and Reuse, Washington, D.C., 1974. Washington, D.C., Information Transfer, Inc. p. 327-365.

Automotive waste oils were found to have physical and combustion properties suitable for auxiliary fuel in a municipal incinerator. It was recommended that the effectiveness of burning waste oil be evaluated for alternate designs, locations and numbers of waste oil burners necessary. Criteria for effectiveness are given.

Waste treatment and disposal methods

C-942-76
WASTE OIL: A RESOURCE TO BE CONSERVED

Chiogioji, M. H. 1974.
Federal Energy Administration, SAE Report 740684. 8 p.

Conservation of waste automotive and industrial oils can result in significant savings. The present primary end uses and the techniques used to reclaim waste oil are described. The factors that restrict waste oil usage are analyzed; they include economics, technology, collection, governmental actions, and environmental quality.

C-943-76
USING WASTE OILS AS AUXILIARY FUEL

Glaesemann, M. T. 1975.
Plant Engineering 29:92.

The use of waste lubricating oils and cutting oils as auxiliary fuel represents a realistic alternative to the expensive storage and disposal of waste oil presently employed. The practical advantages of adding up to 15% waste oil to primary fuel are discussed, and procedural guidelines are presented.

Waste treatment and disposal methods

C-944-76
RE-REFINED DIESEL LOCOMOTIVE LUBRICATING OIL

Liebenow, W. F. 1974.
International Conference on Waste Oil Recovery and Reuse, Washington, D.C., 1974. Washington, D.C., Information Transfer, Inc. p. 295-297.

The success of the C and O Railway in using re-refined lube oil in their diesel locomotives is described. The oil that was re-refined by the railway, from 1952 to 1959, met the same specifications that were used for new oil. Both re-refined and new oils were used in a diesel locomotive in regular service over this period of time. Advantages and disadvantages of using re-refined oil are listed.

C-945-76
WASTE OIL IN MARYLAND: A POLLUTANT OR A RESOURCE

Long, M. T. 1974.
International Conference on Waste Oil Recovery and Reuse, Washington, D.C., 1974. Washington, D.C., Information Transfer, Inc. p. 43-54.

The Maryland Environmental Service and the EPA conducted a survey which determined the amounts and characteristics of waste oils in Maryland and designed a program for the collection, transportation, processing and use of these oils. This waste oil recovery and reuse program is outlined.

C-946-76

AN ECONOMIC MODEL OF WASTE OIL RECOVERY, REPROCESSING AND DISTRIBUTION SYSTEMS

Martin, E. J., and L. McMillan. 1974.
International Conference on Waste Oil Recovery and Reuse, Washington, D.C., 1974. Washington, D.C., Information Transfer, Inc. p. 405-418.

The Cost, Revenue, and Profit (CRP) Model is a mathematical model, developed by the Maryland Waste Oil Recovery and Reuse Program, which calculates the cost of recovery, re-refining and distribution of waste oils. A description of the costs and revenue section of the model is given.

C-947-76

INPLANT RECLAMATION OF USED LUBRICANTS

Oliverson, R. L. 1975.
Plant Engineering 29(11):44-47.

Rerefining oils is not commercially feasible for small volumes; at least 5 million gallons a year must be handled. Those lubricants that can be rerefined include: crankcase lube oil, explosive fluids, very volatile fluids, and overheated or acid oils. Reclaiming, purifying, filtering and conditioning are also discussed.

C-948-76

THE RECOVERY OF WASTE LUBRICATION OIL: A COMPARATIVE NATIONAL ANALYSIS

Pearce, D. 1975.
Resources Policy 1(4):213-229.

Experience in waste oil recovery in Western Europe is compared with that in the United States and relevant legislation is summarized. Information on the used oil process in the United Kingdom is limited.

Foreign legislation

C-949-76

BROOKHAVEN'S ENLIGHTENED SOLUTIONS TO ITS WASTE PROBLEMS

Reid, R. E. 1975.
Compost Science 16(4):8-11.

Brookhaven, the fastest growing township on Long Island, has come up with solutions for the treatment of many varieties of waste; i.e., leaf composting, tree and branch chipping, recycling of waste motor oil, and sewage sludge composting. By ordinance, waste oil is deposited in free tanks where it is picked up by contractors who process and sell it. Ground water is no longer being contaminated by waste petroleum products.

C-950-76
METHOD AND COMPOSITION FOR EMULSIFYING PETROLEUM PRODUCTS WITH A VIEW TO PREPARING A CULTURE MEDIUM FOR MICROORGANISMS

Salomone, G. H. 1974.
British Patent 1,354,543

"Petroleum wastes are mixed with microorganisms nutrient e.g. molasses and a waste organic acid e.g. lactic acid and possibly a waste alkali or alkaline earth salt (approximately 10 wt. % petroleum). Inoculated culture then used for fertiliser production, metals removal etc."

C-951-76
METHODS OF CONSERVING PETROLEUM-BASED FLUIDS

Sayre, R. W. 1975.
Plant Engineering 29(8):205-207.

A program for inplant petroleum-based fluid recovery processes includes minimizing cross-contamination and unnecessary fluid losses, and preventing "designed-in" hydraulic-fluid degradation. Problems associated with industrial lubrication practices are discussed.

C-952-76
MATERIAL GAINS, RECLAMATION, RECYCLING AND RE-USE

Thomas, C. 1974.
Friends of the Earth Ltd. (London). 94 p.

"Extensive summary of methods of regaining value from waste by separation of individual constituents and by bulk treatment of waste."

C-953-76
WASTE OIL--SOLUTION TO MARYLAND'S ENERGY CRISIS

Urmacher, J. C., and B. L. Pollack. 1974.
International Conference on Waste Oil Recovery and Reuse, Washington, D.C., 1974. Washington, D.C., Information Transfer, Inc. p. 301-308.

Technical questions on the use of reprocessed waste oil as fuel oil are considered. Maryland's Environmental Service is re-assessing the ban on lead-bearing fuels and is working to provide a state-controlled source of alternative, lead-free fuel oil manufactured at a state-controlled facility. The facility would eventually accept all oily wastes and provide conversion or ultimate disposal of them.

Waste treatment and disposal methods

C-954-76
EXPERIENCE WITH THE IFP PROPANE CLARIFICATION PROCESS IN RE-REFINING SPENT CRANKCASE OILS

Vu Quang, D., J. W. Andrews, G. Carriero, R. Schieppati, and A. Compte. 1974.
International Conference on Waste Oil Recovery and Reuse, Washington, D.C., 1974. Washington, D.C., Information Transfer, Inc. p. 281-287.

A simple process for propane clarification of spent lube oils prior to conventional acid/clay treatment, developed by the French Petroleum Institute, is described. The process has been shown to lower the amounts of acid and clay needed, reduce sludge formation and pollution, and improve product quality. Yields are high and plant investment and operating costs are low.

C-955-76
OIL REUSE--A NATIONAL NEED

Weinberger, L. W. 1974.
International Conference on Waste Oil Recovery and Reuse, Washington, D.C., 1974. Washington, D.C., Information Transfer, Inc. p. 5-7.

Waste oils can be refined and are a resource which can be utilized to reduce energy and oil shortages. They are currently being disposed of in environmentally harmful ways. An effective waste oil reuse system must include storage, collection, treatment, distribution and sale, licensing, monitoring and surveillance, financing and legislation.

Waste treatment and disposal methods

C-956-76
THE ECONOMICS OF RE-REFINING

Weinstein, N. J. 1974.
International Conference on Waste Oil Recovery and Reuse, Washington, D.C., 1974. Washington, D.C., Information Transfer, Inc. p. 245-260.

The economics of re-refining waste oils and alternative methods of disposing of crankcase waste oils are discussed. Costs are presented for the following re-refining processes: acid/clay treatment; propane extraction/acid/clay treatment; distillation/clay treatment; and distillation/hydrotreatment.

Waste treatment and disposal methods

C-957-76
WASTE LUBRICATING OIL RESEARCH: CHARACTERIZATION OF BASE STOCKS FROM USED LUBRICATING OILS. PART I

Whisman, M. L., F. O. Cotton, J. W. Goetzinger, and J. W. Reynolds. 1975.
Bartlesville Energy Research Center, BERC-RI-75-3. 23 p.

Part one of this four phase study deals with the variation in composition of 10 waste oils received for re-refining. The significance of variation on the re-refining processes is discussed.

C-958-76
QUALITY PRODUCTS FROM USED PETROLEUM OILS

Williams, B. R. 1974.
International Conference on Waste Oil Recovery and Reuse, Washington, D.C., 1974. Washington, D.C., Information Transfer, Inc. p. 239-243.

The possibility and desirability of producing reusable products from waste oil are discussed. The re-refining industry and a profile of the capabilities and benefits of re-refining are described.

8. PERSONNEL TRAINING AND EDUCATION

C-959-76
OIL SPILL CONTROL SCHOOL (AT TAMU)

Anon. 1975.
Marine Technology Society Journal 9(10):45.

An Oil Spill Control School is being conducted by Texas A & M's Moody College of Marine Sciences, Maritime Resources on Pelican Island. The training focuses upon skills in organizing, planning and directing an oil spill cleanup effectively within the legal framework.

Cleanup and recovery

C-960-76
DRILLING PROGRESS--3. TRAINED PERSONNEL: THE KEY TO BLOWOUT PREVENTION

Kendall, H. A. 1975.
World Oil 181(5):67-72.

Equipment and technology cannot prevent blowouts or control well kicks if the personnel on the rig are not properly trained. The procedures to follow in potentially dangerous situations should be familiar to all those connected with the drilling. One operator's plan for well control is reviewed.

Contingency planning

9. CONTINGENCY PLANNING

C-961-76
NATIONAL OIL AND HAZARDOUS SUBSTANCES POLLUTION CONTINGENCY PLAN

Anon. 1975.
Federal Register 40(28):6281-6302.

Guidelines to classify, control and minimize damage from oil and hazardous substances discharges (containment, dispersal and removal) are presented. Responsibilities and duties of federal, state and local agencies are outlined in the contingency plan.

Cleanup and recovery, Containment

C-962-76
SUGGESTED PROCEDURE FOR DEVELOPMENT OF SPILL PREVENTION CONTROL AND COUNTERMEASURE PLANS

Anon. 1974.
American Petroleum Institute Bulletin, No. D16. 39 p.

This study was organized to assist oil and gas producing operators in their efforts to comply with the regulations in Title Code of Federal Regulations, 40, Pt. 112. These regulations are applicable to nontransportation-related onshore and offshore facilities which have discharged or could discharge oil into navigable waters of the U.S. or adjoining shorelines.

U.S. legislation

C-963-76
INDUSTRY EMERGENCY OIL SPILL PLANS AND PROGRAMMES

Brockis, G. J. 1975.
Petroleum and the Continental Shelf of North West Europe.
H. A. Cole (ed.). Barking, United Kingdom, Applied Science
Publishers, 1975. Vol. 2. Environmental Protection. p. 51-54.

The UK Offshore Operators Association (UKOOA) has established stocks of materials and equipment for use in cleaning up oil spills due to offshore activity. Present capabilities and plans for expansion are discussed. The UKOOA equipment can be augmented by that in other countries and through the North Sea Operators Clean Seas Committee.

Cleanup and recovery

C-964-76
SAFEGUARDING THE WATER SUPPLIES IN UPPSALA, SWEDEN

Sidenvall, J. 1974.
Ground Water Pollution in Europe. J. A. Cole (ed.). Conference of the Water Research Association, Reading, England, 1972. p. 9-19.

During the 1950s the groundwater demand increased due to increased population. The city council decided to infiltrate water from the River Fyris into the Uppsala esker to recharge the groundwater. If an oil accident happens, special alarm lists will be followed. People from various institutions will be trained to prevent such pollution from reaching the groundwater supply.

Personnel training and education

C-965-76
A PROGRAM FOR HANDLING EMERGENCY OIL SPILLAGES IN THE PORT OF BALTIMORE

Wilcox, R. 1974.
International Conference on Waste Oil Recovery and Reuse, Washington, D.C., 1974. Washington, D.C., Information Transfer, Inc. p. 225-235.

The programs developed by the Maryland Port Administration which have enabled the State to respond to an emergency oil spill in the Baltimore Harbor area are discussed. The equipment used by this organization to remove oil and debris from the harbor with maximum efficiency is described.

Cleanup and recovery

C. EFFECTS OF OIL POLLUTION

1. BIOLOGICAL EFFECTS

C-966-76
EFFECTS OF LEAD AND HYDROCARBONS FROM SNOWMOBILE EXHAUST ON BROOK TROUT (SALVELINUS FONTINALIS)

Adams, E. S. 1975.
Transactions of the American Fisheries Society 104(2):363-373.

After ice-out in a Maine pond, the lead content rose from 4.1 ppb to 135 ppb, and hydrocarbons rose from undetectable to 10 ppm in the water and 1 ppm in exposed fish. Trout held in aquaria filled with snowmelt containing hydrocarbon exhaust took up both lead and hydrocarbons.

C-967-76
THE EFFECTS OF OIL ON ESTUARINE ANIMALS: TOXICITY, UPTAKE AND DEPURATION, RESPIRATION

Anderson, J. W., J. M. Neff, B. A. Cox, H. E. Tatem, and G. M. Hightower. 1974.
Pollution and Physiology of Marine Organisms. F. J. Vernberg, and W. B. Vernberg (eds.). New York, Academic Press, 1974. p. 285-310.

Laboratory studies on the short-term toxicity, rates of accumulation and release and metabolic response to two crude and two refined oils were conducted. Three organisms were used. Water-soluble fractions of the refined oils were the most toxic. Rates of accumulation were rapid, but the hydrocarbons were only retained briefly. Metabolic responses varied.

C-968-76
SUBLETHAL EFFECTS OF OIL, HEAVY METALS AND PCBs ON MARINE ORGANISMS

Anderson, J. W., et al. 1974.
NTIS, PB-238 514. 48 p.

The state-of-the-art of the study of sublethal effects of 3 common pollutant classes is reviewed. Petroleum hydrocarbons do not bind as firmly or accumulate to such a great extent as the other two classes. The respiratory rate and chloride ion regulation are affected by specific compounds from all classes of pollutants.

C-969-76
No title given (news brief)

Anon. 1976.
Environmental Science and Technology 10(1):11.

A two-year $1.9 million grant to the University of Rhode Island provides for an experimental facility to test the effects of pollutants on marine life. Nine 6-ft. by 15-ft. tanks will be built. If preliminary experiments on oil contaminants are successful, the apparatus will be moved offshore to test long-term effects of low levels of contaminants.

Design and engineering

C-970-76
STUDY OF EFFECTS OF OIL DISCHARGES AND DOMESTIC AND INDUSTRIAL WASTEWATERS ON THE FISHERIES OF LAKE MARACAIBO, VENEZUELA. VOLUME 1. ECOLOGICAL CHARACTERIZATION AND DOMESTIC AND INDUSTRIAL WASTES. VOLUME 2. FATE AND EFFECTS OF OIL

Anon. 1974.
Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA.

Volume 1 contains ecological data on the lake and characterization of both industrial and domestic wastewaters. Volume 2 presents data on the fate and effects of oil on the plants and animals, and also contains hydrocarbon analyses of commercially important fish species.

General fate of oil in the environment, Analysis

C-971-76
EFFECTS OF PETROLEUM POLLUTANTS ON ARCTIC MICROBIAL POPULATIONS

Atlas, R. M., E. A. Schofield, F. A. Morelli, and R. E. Cameron. 1976.
Environmental Pollution 10(1):35-43.

The microbial communities of coastal ponds changed after exposure to Prudhoe Bay crude oil. Bacterial populations greatly increased. In natural oil seeps, there was no vascular plant cover, and fungi were abundant in bacteria-free areas. Lichens appeared to be recolonizing older sections of the seeps. Experimental oil slicks on Prudhoe Bay experienced increases in their bacterial population, but no change in their diversity.

C-972-76
EFFECTS ON SHORE LIFE AND AMENITIES

Baker, J. M. 1975.
Petroleum and the Continental Shelf of North West Europe.
H. A. Cole (ed.). Barking, United Kingdom, Applied Science
Publishers, 1975. Vol. 2. Environmental Protection. p. 85-90.

The effects of oil and cleaning treatments depend on amount and type of oil, type of cleaning treatment and type of biological community. Both field and lab experiments were used to study these effects on a range of shore types. Treatment priorities and recommendations are discussed, with particular reference to Milford Haven.

Cleanup and recovery

C-973-76
THE ECOLOGICAL, CHEMICAL AND HISTOPATHOLOGICAL EVALUATION OF AN OIL SPILL SITE. PART III. HISTOPATHOLOGICAL STUDIES

Barry, M., and P. P. Yevich. 1975.
Marine Pollution Bulletin 6(11):171-173.

Clams surviving the Long Cove, Maine, oil spill were collected and histologically examined. Collections were made from the time of 25% mortality to 85% mortality. A high incidence of gonadal tumors occurred in clams living in areas contaminated by oil. The tumors were malignant neoplasms.

C-974-76
THE EFFECT OF DISSOLVED ORGANIC MATTER IN SEA WATER ON THE UPTAKE OF MIXED INDIVIDUAL HYDROCARBONS AND NUMBER 2 FUEL OIL BY A MARINE FILTER-FEEDING BIVALVE (MERCENARIA MERCENARIA)

Boehm, P. D., and J. G. Quinn. 1976.
Estuarine and Coastal Marine Science 4(1):93-105.

The uptake of a simple hydrocarbon mixture (n-alkane, hexadecane and phenanthrene) and of No. 2 fuel oil by M. mercenaria was studied. Removal of DOM from the seawater uptake media results in an increase in the uptake of hexadecane, no change in uptake of phenanthrene, and a sevenfold increase in the amount of No. 2 fuel oil taken up by the clam. These results indicate that DOM in seawater solubilizes saturated hydrocarbons and makes them less readily taken up by the filter-feeding clam.

Chemical effects of oil pollution

C-975-76
THE ECOLOGICAL EFFECTS OF OIL POLLUTION IN THE MARINE ENVIRONMENT

Boesch, D. F., and C. H. Hershner. 1974.
Oil Spills and the Marine Environment. Cambridge, Mass., Ballinger, 1974. p. 1-55.

The effects of oil on marine ecosystems, including birds, mammals, fish, fisheries, plankton, neuston, intertidal organisms, systems such as coral reefs, polar regions and estuaries are discussed. The types of oil and their weathering characteristics are reviewed.

General fate of oil in the environment

C-976-76
DOES OIL AFFECT THE MARINE ENVIRONMENT?

Brown, J. E. 1975.
Exxon USA 14(3):26-31.

An exhaustive two-year, $1.5 million, multidisciplinary venture called the Offshore Ecology Investigation has tried to answer the question, "What effect if any does long-term offshore oil exploration and production have on the marine environment?" The area investigated was Timbalier Bay and directly southward, an area that has produced oil for more than 20 years. The OEI found, with only minor exceptions, that there is no adverse effect.

Biological effects of oil prospecting and production

C-977-76
TETRACHLORODIBENZODIOXIN: AN ACCIDENTAL POISONING EPISODE IN HORSE ARENAS

Carter, C. D., R. D. Kinbrough, J. A. Liddle, R. E. Cline, M. M. Zack, Jr., R. E. Koehler, P. E. Phillips, and W. F. Barthel. 1975.
Science 188(4189):738-740.

Humans and horses were poisoned by tetrachlorodibenzodioxin contaminated waste oil. The waste oil had been sprayed on riding arenas for dust control. The contamination was a result of the improper disposal of an industrial waste. The pathological effects and chemical identification of the contaminant are described.

Waste treatment and disposal methods

C-978-76
EFFECTS OF 3-4 BENZOPYRENE ON SEA URCHIN EGG DEVELOPMENT

Ceas, M. P. 1974.
Acta Embryologiae Experimentalis No. 3:267-272.

Sea urchin eggs cleave abnormally and develop into irregular morulae if they are exposed to 3-4 benzopyrene. The centrifuged egg has both fluorescent and nonfluorescent components, which indicates that benzopyrene binds itself with the membrane. If separated from the contaminated dark half of the egg, the clear half behaves like the whole egg.

C-979-76
UPTAKE AND LOSS OF PETROLEUM HYDROCARBONS BY THE MUSSEL, 'MYTILUS EDULIS,' IN LABORATORY EXPERIMENTS

Clark, R. C., Jr., and J. S. Finley. 1975.
Fishery Bulletin 73(3):508-515. Also NOAA-750908-8-5, 1974. 9 p.
[COM-75-50192-03-05/GA]

Mussels were exposed to concentrations of No. 2 and No. 5 fuel oil, similar to those found after an oil spill, in a laboratory system that simulated tides. Hydrocarbons were rapidly incorporated and almost entirely lost after 14 days in clean seawater, although traces remained after 35 days. Actual percentage losses and tissue concentrations depend on the initial level of exposure and the limitations of the analytical techniques used.

C-980-76
THE EFFECT OF OIL ON NATURE CONSERVATION, ESPECIALLY BIRDS

Croxall, J. P. 1975.
Petroleum and the Continental Shelf of North West Europe.
H. A. Cole (ed.). Barking, United Kingdom, Applied Science
Publishers, 1975. Vol. 2. Environmental Protection. p. 93-101.

The effects of oil pollution on species diversity and abundance are slight; but, rare, local and certain high-risk species may be endangered. The effects of oil on birds are detailed. Data on bird mortality due to oil show the auk and seaduck to be most vulnerable. Conservation strategies include scaring devices to reduce exposure to oil, new rehabilitation techniques and breeding in captivity.

Reporting, Restoration

C-981-76

THE EFFECT OF OIL POLLUTION IN BANTRY BAY

Cullinane, J. P., P. McCarthy, and A. Fletcher. 1975.
Marine Pollution Bulletin 6(11):173-176.

The biological damage to algae and lichens, caused by the large oil spill in Bantry Bay and attendant cleanup measures, was investigated in 4 visits. Gelatinous or non-crustose lichens absorb oil and are so damaged as to be cleared from the substrate. Since lichens grow so slowly, oil spills occurring less than every 20 years will prevent lichens from ever totally recovering.

C-982-76

LEUKEMIA IN FISH

DaSilva Pitombeira, M., J. M. Martins, and F. V. B. Gomes. 1975.
Medicina (Buenos Aires) 35(3):251-256.

A case of leukemia in the saltwater fish, *Mugil curema*, is described. All fish studied were collected in the port of Fortaleza, Brazil, in waters highly polluted by sewage, oil and petroleum.

C-983-76

EFFECT OF PETROLEUM AND PHENOL ON SOME PROPERTIES OF NUCLEIC ACIDS FROM THE BLACK SEA SHRIMP *PALAEMON ADSPERSUS* [English summary]

Divavin, I. A. 1975.
Biologiya Morya (Vladivostok) (3):62-64.

P. adspersus exposed to petroleum at 0.01 ml/l for 2 hrs. were found to have an increased RNA level and a decreased DNA level. After 5 hrs. of exposure, the RNA level was back to normal and the DNA level increased. Five days after exposure, RNA synthesis and the level of acid-soluble nucleotides increased. Phenol had no significant effect on nucleic acids.

C-984-76

PROBLEMS OF ACUTE AND CHRONIC TOXICITY IN THE MARINE ENVIRONMENT [English summary]

Donnier, B. 1975.
Ingegneria Ambientale 4(2):127-134.

The consequences of marine pollution by heavy metals, hydrocarbons and organochlorine compounds are reviewed. The 43 references cover ecological, biochemical and toxicological effects.

Bibliographies

C-985-76
THE ECOLOGICAL, CHEMICAL AND HISTOPATHOLOGICAL EVALUATION OF AN OIL SPILL SITE. PART I. ECOLOGICAL STUDIES

Dow, R. L., and J. W. Hurst, Jr. 1975.
Marine Pollution Bulletin 6(11):164-166.

An oil spill into Long Cove, Searsport, Maine, lasted 3-1/2 months and involved a minimum of 14 metric tons of oil. Biological surveys of the soft clam before and after the spill demonstrated immediate and continuing mortalities which in 3 years had exceeded 85% of the estimated 50 million market-size clams in the area.

Economic effects of oil pollution

C-986-76
THE EFFECT OF COLD SEAWATER EXTRACTS OF OIL FRACTIONS UPON THE BLUE MUSSEL MYTILUS EDULIS

Dunning, A., and C. W. Major. 1974.
Pollution and Physiology of Marine Organisms. F. J. Vernberg and W. B. Vernberg (eds.). New York, Academic Press, 1974. p. 349-366.

Respiration and survival experiments were conducted on M. edulis. Oxygen uptake is almost completely inhibited at 24% water soluble extract solution and partially inhibited at 12%. Whole oil concentrations were not high enough to inhibit respiration. No. 2 fuel oil prevented abyssal thread formation and decreased the rate of shell closure.

C-987-76
HYDROCARBONS IN BLUE MUSSELS FROM THE KIEL BIGHT

Ehrhardt, M., and J. Heinemann. 1975.
Environmental Pollution 9(4):263-282.

Blue mussels were analyzed for recent biogenic and petroleum-derived hydrocarbons. The hydrocarbon composition varied seasonally due to the variation in recent biogenic hydrocarbons. Mussels are able to degrade or excrete paraffinic fossil or recent biogenic hydrocarbons which they take up from the water or eat with their food, but are less able to dispose of cyclic saturated and aromatic fossil fuel hydrocarbons.

Analysis

C-988-76
TOXICITIES OF CRUDE OILS AND OIL-DISPERSANT MIXTURES TO JUVENILE RABBIT FISH, *SIGANUS RIVULATUS*

Eisler, R., and G. W. Kissil. 1975.
American Fisheries Society, Transactions 104(3):571.

Toxicities to rabbit fish, an economically important teleost, were determined for two crude oils, ST5 (a chemical dispersant) and an oil-ST5 mixture in static and flow-through systems, under different concentrations of toxicants, and in salinities ranging from 20 to 60 0/00. High concentrations of crude oil caused liver enlargement in rabbit fish; ST5 caused reductions in blood hematocrit.

C-989-76
BIOLOGICAL EFFECTS OF CRUDE OILS AND OIL-DISPERSANT MIXTURES ON RED SEA MACROFAUNA

Eisler, R., G. W. Kissill, and Y. Cohen. 1974.
Environmental Protection Agency, EPA 600-4-74. p. 156-179.

"A review with 11 references."

Cleanup and recovery

C-990-76
CHANGES IN POPULATION SIZE AND ALLOZYME FREQUENCIES IN A MARINE OPPORTUNIST CAPITELLA-CAPITATA POLYCHAETA

Grassle, J. F. (date unknown)
International Congress of Systematic and Evolutionary Biology, 1st, University of Colorado, Boulder, Colorado, 1974. p. 124. Abstracts.

Summary not available.

C-991-76
FOLLOW-UP FIELD SURVEY OF THE OIL POLLUTION FROM THE TANKER 'METULA'

Hann, R. W. 1975.
Final report, USCG-D-166-75, Contract DOT-CG-42444A. 59 p.
[AD-A017 100/9GA]

Most of the 20,000 tons of oil which came ashore is still present; it will be a long-term source of water pollution as it leaches and erodes into the water. The intertidal marine life was substantially affected. Marine waterfowl are still suffering from unstabilized oil or mousse at the top of the beach zone, and from eating contaminated mussels.

General fate of oil in the environment, Physical changes of oil in the environment

C-992-76
FIELD STUDIES ON THE PHYTOTOXICITY OF CRUDE OIL TO ARCTIC AQUATIC VEGETATION

Hanna, B. M., J. Hellebust, and T. C. Hutchinson. 1974.
Congress International Association of Limnology, 19th, Winnipeg, Canada, 1974. p. 77. Abstracts.

Summary not available.

C-993-76
ECONOTES

Hanson. D. 1976.
Audubon 78(1):140.

PNAs (polynuclear aromatics), pollutants from coal combustion and petrochemicals, and suspected carcinogens have been discovered in herring gulls in Lake Ontario. Gulls were found to have birth defects and abnormal behavior. Dr. Plakall, Chief of the Canadian Wildlife Toxic Chemicals section, believes the PNAs are a major potential hazard to human health.

C-994-76
CARCINOGENIC SOURCES IN FISH TUMORS FOUND IN THE FOX VALLEY WATER SHED

Hazdra, J. J., E. R. Brown, J. Baudenistel, T. Arndt, and L. Keith. 1974.
American Chemical Society, Division of Environmental Chemistry 14(1):350-355. Preprints.

Fish (4.38%) from the Fox River (Wisconsin and Illinois) had stomach, liver and skin tumors. Only 1.03% of the fish from Lake of the Woods had tumors. Fox River water contained benzanthracene, toluene, benzenes, naphthalene, pesticides, oils, etc., the concentrations of which were below the detection threshold in the Lake of the Woods.

C-995-76
THE ACUTE EFFECTS OF EMPIRE MIX CRUDE OIL ON ENZYMES IN OYSTERS, SHRIMP AND MULLET

Heitz, J. R., L. Lewis, J. Chambers, and J. D. Yarbrough. 1974.
Pollution and Physiology of Marine Organisms. F. J. Vernberg and W. B. Vernberg (eds.) New York, Academic Press, 1974. p. 311-328.

Animals were exposed to oil, then sacrificed. Their tissue enzymes were analyzed spectrophotometrically. Relatively little effect was noted for exposures up to 7 days. Shrimp were the most sensitive of the animals and did exhibit a spiraling behavior. Those enzymes affected were related to carbohydrate metabolism.

C-996-76
COMPARISON OF ECOLOGICAL IMPACTS OF POSTULATED OIL SPILLS AT SELECTED ALASKAN LOCATIONS. VOLUME I. INTRODUCTION, SUMMARY, METHODOLOGY, EVALUATION AND APPENDICES

Isakson, J. S., J. M. Storie, J. Vagners, G. A. Erickson, and J. F. Kruger. 1975.
Final report, USCG-D-155-75-Vol-1, Contract DOT-CG-42913-A. 633 p.
[AD-A017 600/8GA]

The potential environmental impacts of spills of varying amounts of crude oil, diesel-2, bunker C and gasoline on 18 sites in Alaska were ranked. Dispersal mechanisms were assumed to be inertial, viscous and wind and current forces. The impact was estimated using 3-dimensional matrices and was based on estimated species abundance, the importance of the species, and long- and short-term impacts of the oil on these species.

Physical changes of oil in the environment

C-997-76
COMPARISON OF ECOLOGICAL IMPACTS OF POSTULATED OIL SPILLS AT SELECTED ALASKAN LOCATIONS. VOLUME II - RESULTS

Isakson, J. S., J. M. Storie, J. Vagners, G. A. Erickson, and J. F. Kruger. 1975.
Final report, USCG-D-155-75-Vol-2, Contract DOT-CG-42913-A. 865 p.
[AD-A017 601/6GA]

Of all the sites ranked, Port Graham, Valdez Narrows, Unimak Pass, and the Yukon River Crossing had the highest ratings for potential environmental damage due to an oil spill. This held true whether or not cleanup/containment was assumed.

C-998-76
BACTERIAL FLORA OF SOIL AFTER APPLICATION OF OILY WASTE

Jensen, V. 1975.
Oikos 26(2):152-158.

Plate counts and enrichment cultures followed by isolation of pure cultures were used to study the effects of mineral oils and oily wastes on the bacterial flora of the soil. The numbers of bacteria increased after oil application in both field and model experiments. The most important genera were Arthrobacter and Pseudomonas.

Biological degradation

C-999-76
EFFECTS OF PRUDHOE BAY CRUDE OIL ON MOLTING TANNER CRABS, CHINONOECETES BAIRDI

Karinen, J. F. 1974.
Marine Fisheries Review 36(7):31-37.

Static bioassays using Prudhoe Bay crude oil and juvenile male Tanner crabs were performed. Both pre- and postmolt crabs were susceptible to oil, with the 48-hr. TLM being 0.58 ml oil/l. The oil affected molting success and caused newly molted crabs to autotomize limbs. Alaska's Tanner crab resources would be adversely affected by oil spills.

Economic effects of oil pollution

C-1000-76
THE EFFECTS OF WATER SOLUBLE PETROLEUM COMPONENTS ON THE GROWTH OF CHLORELLA VULGARIS BEIJERINCK

Kauss, P. B., and T. C. Hutchinson. 1975.
Environmental Pollution 9(3):157-174.

Aqueous extracts of seven different crude oils and one refined product were tested for their toxic effect upon Chlorella. If the volatile compounds in such extracts were first allowed to evaporate for at least 24 hrs., then the growth rate of Chlorella cells was not inhibited, and in some cases was actually stimulated. Cause of this growth stimulation remains uncertain.

C-1001-76
STUDIES ON THE SUSCEPTIBILITY OF ANKISTRODESMUS SPECIES TO CRUDE OIL COMPONENTS

Kauss, P. B., and T. C. Hutchinson. 1974.
Congress International Association of Limnology, 19th, Winnipeg, Canada, 1974. p. 102. Abstracts.

Summary not available.

C-1002-76
THE EFFECTIVENESS AND TOXICITY OF THE OIL DISPERSANT, OILSPERSE 43, IN LARGE OUTDOOR TANKS

Keizer, P. D., and P. G. Wells. 1975.
Canada. Fisheries and Marine Services, Bedford Institute of Oceanography, EPS-5-AR-75-8. 28 p.

A mixture of Oilsperse 43 and crude oil was more homogeneous, less viscous and without the 'crust' of plain oil. A weathered crude and dispersant mixture was lethal to >50% of the green sea urchins whereas crude oil was not. Similarly effective, 'low-toxicity' dispersants used on an inshore spill could reach concentrations lethal to the green sea urchin.

Cleanup and recovery

C-1003-76
EFFECTS OF CRUDE OIL ON MARINE INVERTEBRATES

Kittredge, J. S. 1975.
Final report, Contract N00014-68-A-0105-0007. 7 p. [AD-A017 921/8GA]

Laboratory studies indicate that the polyaromatic hydrocarbon compounds are the potentially dangerous component of oil pollution. Sublethal amounts inhibit chemoreception in marine invertebrates and therefore may drastically limit the productivity of a marine habitat.

Chemical effects of oil pollution

C-1004-76
HYDROCARBON EFFECTS ON CARBON-14 UPTAKE BY ALGAE INDIGENOUS TO LAKE GEORGE, NEW YORK

Kumar, I. J., and N. L. Clesceri. 1974.
Congress International Association of Limnology, 19th, Winnipeg, Canada, 1974. p. 111. Abstracts.

Summary not available.

C-1005-76

THE EFFECT OF ALASKAN CRUDE OIL AND SELECTED HYDROCARBON COMPOUNDS ON EMBRYONIC DEVELOPMENT OF THE PACIFIC OYSTER, *CRASSOSTREA GIGAS*

LeGore, R. S. 1975.
University of Washington, College of Fisheries, Research in Fisheries No. 415. p. 77-78.

The toxicities of Prudhoe Bay crude oil and several hydrocarbon components of petroleum were evaluated. High doses of extract inhibit development. Toxicity appears to increase with boiling point, and to be unrelated to solubility in water. The veliger larvae showed no avoidance response to the crude oil, but in 25-40 min. ciliary coordination was lost and the larvae sank.

C-1006-76

EFFECTS OF OIL ON THE REPRODUCTION OF THE AMPHIPOD *GAMMARUS OCEANICUS*

Lindén, O. 1976.
Ambio 5(1):36-37.

Sub-lethal levels of Venezuelan crude oil decreased the brood numbers if the female amphipod was exposed to oil during the incubation period. Length of incubation time was not affected. The frequency with which male and female amphipods entered the precopulation stage decreased under exposure to low levels of oil in the water.

C-1007-76

THE EFFECTS OF OIL DISPERSANTS ON THE CELL IN FERTILIZATION AND DEVELOPMENT

Lonning, S., and B. E. Hagstrom. 1975.
Norwegian Journal of Zoology 23(2):131-134.

Larvae from sea urchins and two species of marine fish were exposed to 9 dispersants. All 9 negatively affected sea urchin fertilization and inhibited development of the skeleton and endoderm. Both sea urchin and fish larvae experienced pathological effects and rapid cytolosis after exposure to some substances.

Cleanup and recovery

C-1008-76
THE EFFECTS OF AN OIL SPILL ON THE MACRO INVERTEBRATES AND FISHES OF PLUM CREEK IN SOUTHWESTERN VIRGINIA USA

Masnik, M. T., J. R. Stauffer, C. H. Hocutt, and J. H. Wilson. 1974.
Associated Southeast Biological (ASB) Bulletin 21(2):68.

Collections of benthic macroinvertebrates and fishes were taken from Plum Creek in Southwestern Virginia to assess the biological damage caused by a 4,000 liter oil spill entering the Creek in May, 1973. Immediate mortality of organisms was minimal. Benthic macroinvertebrates did not exhibit significant decreases in numbers at the site of the spill; however, downstream stations did show a decrease in the total number of these organisms and a reduction in the number of fish taxa after the spill.

Reporting

C-1009-76
MEDICAL ASPECTS OF ESTUARIAL POLLUTION

McGregor, A. 1975.
Conference on Pollution Criteria for Estuaries, University of Southampton, U.K., 1973. P. R. Helliwell, and J. Bossanyi (eds.). London, Pentech Press Ltd., 1975. p. 3.1-3.18.

The source and medical amenity effects of medically important pollutants are discussed. The types are bacterial and viral pollution, chemical pollution (including oil), waste, heat, and noise. Shellfish sampling during 1971 and 1972 resulted in a recommendation that shellfish harvesting for human consumption be forbidden in certain districts in the U.K.

Economic effects of oil pollution

C-1010-76
EFFECTS OF POLLUTION ON FRESHWATER FISH

McKim, J. M., D. A. Benoit, K. E. Kiesinger, W. A. Brungs, and R. E. Siefert. 1975.
Journal, Water Pollution Control Federation 47(6):1711-1783.

This literature review on the effects of pollution on freshwater fish includes sections on methodology, water quality, pesticide pollutants, industrial pollutants, domestic and chlorinated pollutants, radioactive and other pollutants. A table provides a summary of the acute and chronic toxicity of these pollutants (including oil).

Bibliographies

C-1011-76

ACUTE TOXICITY OF BENZENE, A COMPONENT OF CRUDE OIL, TO JUVENILE STRIPED BASS (*MORONE SAXATILIS*)

Meyerhoff, R. D. 1975.
Journal of the Fisheries Research Board of Canada 32(10):1864-1866.

The acute toxicity of benzene to 1.5 ± 0.5 gm juvenile striped bass was studied in a continuous flow laboratory bioassay system. The lethal threshold concentration and the 96-hr. LC50 for benzene were both 10.9 μl/liter, when the environmental conditions were at 17.4°C and 29 ppt salinity. Possible toxic mechanisms are discussed.

C-1012-76

BACTERIAL ATTACK OF CORALS IN POLLUTED SEAWATER

Mitchell, R., and I. Chet. 1975.
Microbial Ecology 2(3):227-233.

When coral heads were exposed to low concentrations of crude oil, copper sulfate, potassium phosphate or dextrose, they died in 5 to 10 days. Corals exposed to these chemicals produced large amounts of mucus. Since the addition of antibiotics prevented these deaths, predatory bacteria are suspected to be the destroying agents.

C-1013-76

OFFSHORE OIL SPILLS AND THE MARINE ENVIRONMENT

Moore, S. F. 1976.
Technology Review 78(4):61-67.

The author discusses a study prepared for the Council on Environmental Quality to assess potential biological effects of hypothetical discharges. The study did not predict spill effects in quantitative terms; however, by studying the initial impacts of a spill and the recovery period, rough "order-of-magnitude" estimates could be made. Results from studies of hypothetical offshore drilling sites along the Atlantic and Alaskan coasts revealed that none of the hypothesized spills from the Atlantic offshore sites is expected to cause significant biological damage to nearshore habitats. No conclusions were drawn regarding the effects of spills on the Alaskan coast.

Biological effects of oil prospecting and production

C-1014-76
EFFECTS OF SOME COMPONENTS OF CRUDE OIL ON YOUNG COHO SALMON

Morrow, J. E., R. L. Gritz, and M. P. Kirton. 1975.
Copeia (2):326-331.

Aliphatic compounds caused no significant mortalities in young coho salmon; mono-cyclic aromatics were generally toxic. The cause of the toxicity may be alterations in cell membrane permeability, particularly in the gills. This would cause an increase in the concentration of monovalent ions in the blood and also interfere with the CO_2-HCO_3^- regulatory system.

C-1015-76
EFFECTS OF LONG-TERM, LOW LEVEL EXPOSURE TO OIL

Nelson-Smith, A. 1975.
Petroleum and the Continental Shelf of North West Europe.
H. A. Cole (ed.). Barking, United Kingdom, Applied Science Publishers, 1975. Vol. 2. Environmental Protection. p. 105-111.

Species and developmental stages of organisms vary in their sensitivity to oil. Sublethal effects may render particular groups incapable of competing. If an excluded species has a key ecological role, major changes may occur. Humans will be affected according to the commercial or aesthetic values placed on certain biotic communities.

C-1016-76
MASSIVE VISCERAL LIPID DEPOSITION FOLLOWING PROLONGED MINERAL OIL DEPOSITION

Nochcmovitz, L. E., and C. J. Uys. 1974.
South African Jounral of Laboratory Clinical Medicine 20(2):1226.
Abstract.

Summary not available.

C-1017-76
EFFECTS OF OIL ON BALTIC LITTORAL COMMUNITY, AS STUDIED IN AN OUTDOOR MODEL TEST SYSTEM

Notini, M., and A. Hagstrom. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop, National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.).
NBS Special Publication No. 409. p. 251-254.

Small outdoor pools were set up as models of the Baltic littoral ecosystem and included Fucus vesiculosus and macrofaunal species.

Oil spills were simulated, and samples were taken before and after the addition of oil. Two types of affinity indexes were used to analyze the samples and determine possible changes in the structure of Fucus communities.

C-1018-76
COMPOUND FROM FLOATING PETROLEUM ACCUMULATING IN FISH

Ogata, M., and Y. Miyake. 1975.
Water Research 9(12):1075-1078.

The objective of this study was to determine the petroleum components that accumulate in fish. The presence of the compounds was measured in the fish and the surrounding water. Toluene accumulated most rapidly. The two methods of recovery differed, so calibration curves were used for quantitative measurements.

Analysis

C-1019-76
METABOLISM AND ACCUMULATION OF PETROLEUM COMPONENTS IN FISH--SIDE CHAIN OXIDATION OF PARA-NITROTOLUENE AND PARA-NITROBENZYL ALCOHOL IN LIVER HOMOGENATES OF RAT AND EEL

Ohmori, S., M. Ikeda, and M. Ogata. 1975.
Physiological Chemistry and Physics 7(5):477-480.

Previous chromatographic analyses of petroleum substances causing objectionable odor in fish have demonstrated the presence of toluene and benzene. In this paper the authors report that eel liver homogenates metabolize the methyl group of p-nitrotoluene (PNT), a model compound of toluene, more slowly than rat liver homogenates. This could explain the accumulation of toluene in fish.

Analysis

C-1020-76
RESPONSES OF ARCTIC MARINE CRUSTACEANS TO CRUDE OIL AND OIL-TAINTED FOOD

Percy, J. A. 1976.
Environmental Pollution 10(2):155-162.

Three species of benthic crustaceans were exposed to oil masses. No species were attracted to the oil, but the degree of avoidance varied with the species, type of crude oil, degree of weathering, and the animals' acclimation to oil emulsions. Untainted food was preferred by the 2 amphipods, but the isopod appeared oblivious to the presence of oil in its food or environment.

C-1021-76
EFFETS DES POLLUTIONS CHIMIQUES VIS-A-VIS DE TELEMEDIATEURS INTERVENANT DANS L'ECOLOGIE MICROBIOLOGIQUE ET PLANCTONIQUE EN MILIEU MARIN: 3^{e} PARTIE [English summary]

Pesando, D., and M. Aubert. 1975.
Revue Internationale d'Oceanographie Medicale (39-40):109-116.

Various pollutants were tested for their effects on *Peridinium trochoideum*, a growth inhibitor of the diatom, *Asterionella japonica*. Hydrocarbons, detergents, pesticides, industrial sewages and effluent metals were tested. Lower sublethal concentrations sometimes had a positive effect; other concentrations had growth inhibiting effects.

C-1022-76
EFFECTS OF TEMPERATURE ON OIL REFINERY WASTE TOXICITY

Reynolds, J. H., E. J. Middlebrooks, D. B. Porcella, and W. J. Grenney. 1975.
Journal Water Pollution Control Federation 47(11):2674-2693.

Temperature effects on the toxicity of oil refinery waste to algae were predicted using a continuous flow kinetic model based on enzyme inhibition kinetics. A model using *Selenastrum capricornutum* and phenol was tested at temperatures between 20 and 33°. Both phenol and the oil refinery waste were more toxic at 24° than at any other temperature.

C-1023-76
EFFECTS OF NORMAN WELLS CRUDE OIL ON PERIPHYTON IN SELECTED LAKES AND RIVERS IN THE NORTHWEST TERRITORIES

Roeder, D. R., G. H. Crum, D. M. Rosenberg, and N. B. Snow. 1975.
Canada. Fisheries and Marine Service, Research and Development Directorate, Technical report No. 552. 31 p.

Styrofoam balls and plexiglass plates were used as artificial substrate samplers in experiments designed to test the effect of Norman Wells crude oil on periphyton. Oiled treatments supported a different algal community than controls; numbers of species were occasionally more, and never less than controls. Blue-green algae were more abundant on oiled substrates; this may become a matter of concern.

C-1024-76
EFFECT OF CRUDE OIL ON ZOOBENTHOS COLONIZATION OF ARTIFICIAL SUBSTRATES IN SUBARCTIC AQUATIC ECOSYSTEMS

Rosenberg, D. M., and N. B. Snow. 1974.
Congress International Association of Limnology, 19th, Winnipeg, Canada, 1974. p. 177. Abstracts.

Summary not available.

C-1025-76
TOXICITY OF WATER-SOLUBLE FRACTIONS OF FOUR TEST OILS FOR THE POLYCHAETOUS ANNELIDS, NEANTHES ARENACEODENTATA AND CAPITELLA CAPITATA

Rossi, S. S., J. W. Anderson, and G. S. Ward. 1976.
Environmental Pollution 10(1):9-18.

Of the 4 water-soluble fractions of oil tested, the 2 refined oils were more toxic than the 2 crude oils. The refined oils contain more diaromatic compounds (naphthalenes) which is the probable reason for their increased toxicity. Although the 2 species of annelids differed slightly in sensitivity, they were similar to fish and crustaceans in their reactions to these 4 oils.

C-1026-76
EFFECTS OF CRUDE OIL ON POPULATIONS OF BACTERIA AND ALGAE IN ARTIFICIAL PONDS SUBJECT TO WINTER WEATHER AND ICE FORMATION

Shindler, D. B., B. F. Scott, and D. B. Carlisle. 1974.
Congress International Association of Limnology, 19th, Winnipeg, Canada, 1974. p. 191. Abstracts.

Summary not available.

C-1027-76
CRUDE OIL AND NUTRIENT ENRICHMENT STUDIES IN A MACKENZIE DELTA LAKE

Snow, N. B., and G. J. Brunskill. 1975.
Canada. Fisheries and Marine Service, Research and Development Directorate, Technical report No. 553. 7 p.

Four clear polyethylene tubes were filled with lake water and placed in a Mackenzie Delta lake in August, 1973. One tube was enriched 100-fold with N and P, one had 4 litres of crude oil added, one with N and P and crude oil, and the last was used as a control. Light attenuation and oleoclastic organism activity were used to explain the results.

C-1028-76
ASPECTS OF ZOOBENTHOS ECOLOGY OF THE MACKENZIE DELTA NORTHWEST TERRITORIES

Snow, N. B., and P. Chang. 1974.
Congress International Association of Limnology, 19th, Winnipeg, Canada, 1974. p. 193. Abstracts.

Summary not available.

C-1029-76
THE EFFECTS OF AQUEOUS EXTRACTS OF CRUDE OIL AND NAPHTHALENE ON THE PHYSIOLOGY AND MORPHOLOGY OF A FRESHWATER GREEN ALGA

Soto, C., J. A. Hellebust, and T. C. Hutchinson. 1974.
Congress International Association of Limnology, 19th, Winnipeg, Canada, 1974. p. 194. Abstracts.

Summary not available.

C-72-76
BIOLOGICAL ENVIRONMENTAL EFFECTS

Stansby, M. E. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop, National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.). NBS Special Publication No. 409. p. 45-48.

The research programs underway at the Northwest Fisheries Center on the biological effects of oil pollution are described. The work consists of chemical, physiological and behavioral research on the long-term chronic effects of oil on fish. The author stresses that those monitoring pollutants and those studying the effects should be in close communication.

Monitoring

C-1030-76
COMPARING TOXICITY OF CERTAIN OIL PRODUCTS USED AS DIELECTRICS IN ELECTROEROSIVE WORKING. I. ACUTE AND SUBACUTE TOXICITY [English summary]

Starek, A., L. Fiema, D. Cembala, and W. Lepiarz. 1975.
Medycyna Pracy 26(3):219-230.

Low acute toxicity was induced in rats fed large doses of kerosene, diesel oil, transformer and turbine oils and Mentor 28. The changes observed were in the peripheral red and white blood cell systems and blood platelet number.

C-1031-76

HYDROCARBONS IN SHELLFISH CHRONICALLY EXPOSED TO LOW LEVELS OF FUEL OIL

Stegeman, J. J. 1974.
Pollution and Physiology of Marine Organisms. F. J. Vernberg, and W. B. Vernberg (eds.). New York, Academic Press, 1974. p. 329-348.

Uptake level, residence duration, and hydrocarbon composition in shellfish exposed to low levels of petroleum were investigated. Uptake and disposal rates were linked to the concentration of the contaminant and the lipid character. Classes of hydrocarbons behave in a chemically distinct manner on the oyster. Lower molecular weight aromatics are toxic and have a longer biological half-life.

C-1032-76

POLYNEUROPATHY CAUSED BY PETROLEUM BENZINE

Takeuchi, Y., C. Mabuchi, and S. Takagi. 1975.
Internationales Archiv fuer Arbeitsmedizin 34(3):185-198.

Four workmen who were clearing Nishijin brocade sashes with petroleum benzine in a poorly ventilated workshop were diagnosed as having polyneuropathy with remarkable muscular atrophy. These symptoms were similar to those caused by commercial n-hexane, a component of benzine. But the CNS disorders due to benzine exposure were more severe.

C-1033-76

INCREASED OPERCULAR RATES OF PINK SALMON (ONCORHYNCHUS GORBUSCHA) FRY AFTER EXPOSURE TO THE WATER-SOLUBLE FRACTION OF PRUDHOE BAY CRUDE OIL

Thomas, R. E., and S. D. Rice. 1975.
Journal of the Fisheries Research Board of Canada 32(11):2221-2224.

The opercular rates of the pink salmon increased significantly for 9 to 12 hours after exposure to water-soluble fractions of oil-water solutions. Increases in rates were proportional to increases in dose. Recording changes in opercular rates is a suitable method for detecting sublethal physiological effects of stress.

C-1034-76
INFLUENCES OF OIL SPILL EMULSIFIERS ON MARINE LIFE [English summary]

Tokuda, H. 1975.
Yukagaku 24(11):766-776.

A review with 56 references.

Cleanup and recovery

C-1035-76
THE EFFECT OF OIL POLLUTION OF SOIL ON GERMINATION, GROWTH AND NUTRIENT UPTAKE OF CORN

Udo, E. J., and A. A. A. Fayemi. 1975.
Journal of Environmental Quality 4(4):537-540.

Corn was grown on soil polluted by crude oil (0 to 10.6%). At 4.2% by weight crude oil pollution, yields were reduced by 92%. Organic C, total N, and exchangeable K, Fe and Mn increased with pollution, whereas extractable P, NO_3-N and exchangeable Ca were reduced. Poor growth was due to suffocation, interference with plant-soil-water relationships and excess Mn and sulfides.

C-1036-76
THE ROLE OF DISPERSION IN FUEL OIL BIOASSAY

Vanderhorst, J. R., C. I. Gibson, and L. J. Moore. 1976.
Bulletin of Environmental Contamination and Toxicology 15(1):93-100.

The research objective was to measure aqueous phase concentrations of No. 2 fuel oil and mortality of coon stripe shrimp (Pandalus danae) when three different methods of oil-seawater contact were used. In these methods, identical volumes of oil and water resulted in significant differences in observed mortality and measured amounts of oil in the water column, either as total or soluble oil.

Analysis

C-1037-76
OIL THREAT TO BIRDS ON THE CANADIAN WEST COAST

Vermeer, K., and R. Vermeer. 1975.
The Canadian Field-Naturalist 89(3):278-298.

Present oil shipping and increased traffic in 1977 are a threat to the aquatic birds and their feeding habitat along the British

Columbia coast. Breeding populations of alcids and winter diving ducks will be most directly affected by spills, whereas those birds feeding in the intertidal zone will be hardest hit indirectly by destruction of their feeding habitat.

C-1038-76

OCCUPATIONAL AND NON-OCCUPATIONAL SCROTAL CANCER IN SWEDEN, 1958-1970

Wahlberg, J. E. 1974.
Acta Dermatovener (Stockholm) 54(6):471-474.

Occupational history and exposure-to-oil data were obtained on 34 cases of scrotal squamous cell carcinoma. Twenty-one percent had been exposed to oil as automatic lathe operators, indicating a possible causal relationship. The majority of the cases were of non-occupational origin, however.

C-1039-76

FLOATING SCARECROW

Wyman, H., Jr. 1975.
Petroleum Today 16(2):29.

Suisan Marsh, California, is 5 miles from loading docks for oil tankers. An API sponsored research project involves counting the birds using a floating scarecrow that produces shrieks, sirens, grumbles, etc., and then recounting the birds. Hopefully the scarecrow will discourage birds from landing on the inviting calm of an oil spill.

Design and engineering

2. PHYSICAL EFFECTS

C-1040-76
HEAT BUDGET OF OIL CONTAMINATED SEA ICE

Weir, C. R. 1975.
Florida Scientist 38(supplement 1):14.

Field studies of oil polluted ice were conducted in the Arctic to determine the physical effects of the contamination. Measurements of albedo, incoming short- and long-wave radiation, surface temperature, transmitted short-wave radiation, relative humidity and ice ablation rates indicate that a contaminated ice field will be destroyed, allowing an ice free ocean to absorb a large amount of previously unavailable energy.

3. CHEMICAL EFFECTS

C-1041-76
GROUND-WATER POLLUTION PROBLEMS IN THE NORTHWESTERN UNITED STATES

van der Leeden, F., L. A. Cerillo, and D. W. Miller. 1975.
U.S. Environmental Protection Agency, Office of Research and
Development, Ecological Research Series EPA-660/3-75-018. 375 p.

The most common groundwater quality problems in the northwestern U.S. are hardness and excessive Fe, Mg, and Fl. Among the principal identified sources of man-caused groundwater problems are abandoned oil wells, shallow disposal wells and inclined surface impoundments. Few such pollution sources and cases have been investigated in detail. Baseline water quality data and systematic evaluation of overall groundwater conditions are needed in areas of petroleum exploration and development.

Chemical effects of oil prospecting and production

C-1042-76
SOIL AND GROUNDWATER CONTAMINATION BY OIL SPILLS; PROBLEMS AND REMEDIES

Vanloocke, R., R. DeBorger, J. P. Voets, and W. Verstraete. 1975.
The International Journal of Environmental Studies 8(2):99-111.

Groundwater pollution by hydrocarbons is quite frequent. There are two methods of cleaning up oil spilled on soils: mechanical removal or microbial degradation. The latter is necessary if the groundwater reservoirs are already contaminated. Time for microbial cleanup can be decreased from decades to several months by providing the optimum nutrient balance.

Biological degradation, Cleanup and recovery

4. ECONOMIC EFFECTS

C-1043-76
MARINE INSURANCE: THE UNDERWRITING SCENE IN 1973

Anon. 1974.
Shipping World & Shipbuilder 167(3889):43, 45, 47.

The three basic problems faced by insurance underwriters are competition, inflation and currency devaluation. Specific situations, such as the responsibility for oil pollution from tanker salvage, the economic feasibility of nuclear vessels and the 14 ships which were confined in the Suez Canal in 1967, are discussed.

C-1044-76
CLEANING UP: THE COST OF REFINERY POLLUTION CONTROL

Boothe, J. N. 1975.
Council on Economic Priorities Report. 115 p.

The oil refinery industry will have to invest $3.35 billion for pollution control from 1974-83. Over half of that amount is needed to bring existing refineries up to standards. The refined oil will cost 0.3 ¢/gallon more than if pollution control was not improved. The costs to individual companies are variable; Gulf will spend 40% more per barrel than Atlantic Richfield.

Waste treatment and disposal methods, U.S. legislation

C-1045-76
TORREY CANYON: A CASE STUDY IN ACCIDENTAL POLLUTION

Burrows, P., C. Rowley, and D. Owen. 1974.
Scottish Journal of Political Economy 21(3):237-258.

The range of policy choices available at the time of a tanker grounding is explored. In the case of the Torrey Canyon oil spill, the economic implications of the policies chosen are examined. Cost figures for the various phases of the cleanup are given. Environmental implications of the spill and the legal question of marine property rights are reviewed.

Cleanup and recovery, General effects of oil pollution, Foreign legislation

C-1046-76
ECONOMIC EFFECTS OF ENFORCEMENT VARIABLES ON COMMERCIAL OIL POLLUTION CONTROL STRATEGY

Cook, R. C. 1975.
Naval Postgraduate School, Master's thesis. 91 p. [AD-A016 442/6GA]

An economic decision model for oil pollution strategy is developed and used to analyze data from PIRS (Pollution Incident Reporting System). The impact of various factors on a firm's pollution control strategy is shown. The control of minor spills is affected by civil penalties, the control of larger spills by internal costs. Notes on an oil spill incident cost model are included.

U.S. legislation

C-1047-76
CAPITAL EXPENDITURES BY BUSINESS FOR AIR AND WATER POLLUTION ABATEMENT, 1973 AND PLANNED 1974

Cremeans, J. E. 1974.
Survey of Current Business (July):58-64.

The expenditures for changes-in-production-process and for new plants and equipment are tabulated by industry. Those industries having the highest expenditures in new plants and equipment for both years are electric utilities, petroleum, chemical, nonferrous metals and paper.

C-1048-76
A SOLUTION TO THE PROBLEM OF PRIVATE COMPENSATION IN OIL DISCHARGE SITUATIONS

Post, T. R. 1974.
University of Miami Law Review 28(3):524-550.

The possibility of being compensated for environmental damage due to oil discharge is examined. The choice of a federal or state court and concepts of tort liability are discussed. Presently, no federal system of relief exists; related state statutes are discussed. The author suggests the establishment of a fund for compensation.

U.S. legislation, State legislation

5. GENERAL EFFECTS

C-1049-76
DEVELOPING THE THIRD WORLD

Anon. 1976.
Marine Pollution Bulletin 7(1):1-2.

The environmental problems arising in developing Indonesia are discussed. A continual risk of oil pollution exists in Indonesian waters due to the heavy traffic of ships and supertankers through the Straits of Malacca. Oil pollution from shipping and offshore oil rigs is viewed as a threat to the development of deep-sea fishing. The effects of this pollution on coral reef and mangrove swamp communities have not yet been assessed.

Biological effects of oil pollution
General effects of oil prospecting and production

C-1050-76
EFFECTS OF MAN'S ACTIVITIES ON THE MARINE ENVIRONMENT

Anon. 1975.
U.S. 94th Congress, 1st Session. Senate. Committee on Commerce. National Ocean Policy Study. Washington, D.C., Government Printing Office, 1975. 135 p.

The broad range of subjects covered include overall assessment of man-caused pollution of marine environments and of specific pollutants, including petroleum. The report stresses need for establishing chemical, physical and biological baselines in monitoring pollution. National and international legislation regarding oil and other ocean pollutants are summarized and discussed.

U.S. legislation, International legislation

C-1051-76
EXPENDITURE SHOULD BE SOONER RATHER THAN LATER. THE ROYAL COMMISSION ON ENVIRONMENTAL POLLUTION IN THEIR FOURTH REPORT: POLLUTION CONTROL, PROGRESS AND PROBLEMS

Anon. 1975.
Waste Water Treatment 18(1):14, 30.

The fourth report of the Royal Commission on Environmental Pollution covers pollution problems caused by DDT, oil and nitrates.

The effect of Britain's membership in the European Common Market, the need for a pollution data bank, and for further emphasis on estuary cleaning, coordinated training programs and better monitoring practices are also discussed.

Personnel training and education, Monitoring, Reporting

C-1052-76
HARMFUL SUBSTANCES IN THE SEA

Anon. 1974.
Ocean Management 2(1):89-93.

Tables from the Report of the Fifth Session of the Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP) (1973) are reproduced. Major categories of marine pollution, including oil, are ranked according to their harmful effects on health, living resources, etc. The different routes by which pollutants enter the sea are also ranked.

Biological effects of oil pollution, Economic effects of oil pollution, Social effects of oil pollution, Reporting

C-1053-76
INSTITUTE OF ENVIRONMENTAL SCIENCES TECHNICAL MEETING, 21ST, 1975.
VOL. 1. ENERGY AND THE ENVIRONMENT

Anon. 1975.
Mt. Prospect, Illinois, Institute of Environmental Sciences, 1975.
260 p.

Topics covered at the conference include the interaction of oil spills and oil slicks with marine environments, and impact of oil on land environments.

General fate of oil in the environment

C-1054-76
OIL SPILLS AND THE MARINE ENVIRONMENT

Boesch, D. F., C. H. Hershner, and J. H. Milgram. 1974.
Cambridge, Mass., Ballinger Publishing Co., 1974. 129 p.

The book is part of the Energy Policy Project which was commissioned by the Ford Foundation in 1971. Scientific knowledge of oil pollution in the marine environment, such as the long-term effects of chronic contamination by hydrocarbons, is still very incomplete. Limited ecological information and the possibility of technical and human error must all be included and considered when determining oil-handling procedures, regulations, contingency plans and personnel training.

General fate of oil in the environment, Personnel training and education, Contingency planning

C-1055-76
GROUNDWATER POLLUTION IN EUROPE

Cole, J. A. (ed.). 1974.
Conference of the Water Research Association, Reading, England, 1972. 516 p.

The proceedings of the conference on groundwater pollution in Europe contains papers on legal and administrative measures to protect aquifers, hydrogeology and hydraulics of pollution movement underground, chemistry and the interaction of pollutants with aquifers, microbiology of groundwater pollution, case histories of pollution occurrences (oil and petrochemical pollution is included), tracing the movement of groundwaters, and deep well waste disposal and borehole technology.

Reporting, Physical changes of oil in the environment

C-1056-76
VULNERABILITY MODEL. A SIMULATION SYSTEM FOR ASSESSING DAMAGE RESULTING FROM MARINE SPILLS

Eisenberg, N. A., C. J. Lynch, and R. J. Breeding. 1975.
Final report, USCG-D-136-75, Contract DOT-CG-33377-A. 354 p.
[AD-A015 245/4GA]

The vulnerability model (VM) is a computerized simulation system designed to assess damage from oil spills. The final report contains descriptions of the research background, computational techniques and preliminary test results. Some aspects of the model could be improved by augmentation, an increase in precision, or both.

C-1057-76
CHEMICAL CYCLES AND THE GLOBAL ENVIRONMENT: ASSESSING HUMAN INFLUENCES

Garrels, R. M., F. T. Mackenzie, and C. A. Hunt. 1975.
Los Altos, California, William Kaufman, Inc., 1975. 218 p.

Natural materials flow through the exogenic cycle, from atmosphere to land to streams to oceans and back to the atmosphere or are deposited as sediment. The effects of pollution (including petroleum) on the exogenic cycle and the response of the environmental processes and cycles are evaluated.

Physical effects of oil pollution

C-1058-76
ENERGY VERSUS THE ENVIRONMENT: THE ISSUES

Holleb, D. B., and G. Alexander. 1975.
Report on Environmental Pollutants and the Urban Economy, NSF/RA/E-75-045, Grants NSF-AG-352, NSF-GI-32989. 35 p.

The following are among the topics listed in the contents: What is energy-related pollution; the spatial aspects of pollution; the effects of the energy crisis on pollution regulation; state and federal impacts of the energy situation; and energy and American values.

C-1059-76
INTERNATIONAL EXPLORATION LOCATES MINERALS AND OILS

Jennings, F. D. 1975.
Sea Technology 16(1):29-30.

Studies by the Living Resources, Seabed Assessment, Environmental Forecasting and Environmental Quality programs of the International Decade of Ocean Exploration have investigated the location of natural oil accumulations, areas of pollution, and the effects of pollution on marine organisms. The role of the ocean in weather and climate and oceanic circulation are the major research areas of these programs.

Biological effects of oil pollution, General fate of oil in the environment

C-1060-76
DEVELOPMENT OF A PROCEDURE TO USE RELATIVE SPILL DILUTION CAPACITY TO MANAGE WATER POLLUTION RISK FROM THE TRANSPORTATION OF OIL AND HAZARDOUS MATERIALS

Jensen, P. A. 1975.
Dissertation Abstracts International, Section B 36(5):2382-B.

A weakness of the present regulatory efforts for the bulk carriage of oil and hazardous materials is the lack of consideration of widely varying risk levels. A procedure is suggested to better quantify severity of spill impact.

C-1061-76
ENVIRONMENTAL ENGINEERS' HANDBOOK. I. WATER POLLUTION

Liptak, B. G. 1974.
Radnor, Pennsylvania, Chilton Book Co., 1974. Vol. 1, 2018 p.

This first volume of three is devoted to water pollution. The different chapters cover such topics as laws and regulations; the types of water pollutants and their effects; the techniques and instruments available for waste water treatment; and recycling, recovery, salvaging and reuse potentials of pollutants.

Waste treatment and disposal methods, Analysis, U.S. legislation

C-1062-76
ENVIRONMENTAL ISSUES SERIES: WATER POLLUTION

McCaull, J., and J. Crossland. 1974.
New York, Harcourt Brace, 1974. 206 p.

Water pollution problems examined in this book include bacterial contamination, dumping of organic wastes that deplete oxygen content, algal overgrowth, industrial chemicals and thermal pollution. One section deals with the development of the modern supertanker and the resulting increase in pollution at sea. The events surrounding the oil spill incidents of the "Torrey Canyon" (1967) and the "Marpessa" (1969) are discussed.

Oil transfer and transport

C-1063-76
ENVIRONMENTAL POLLUTION CONTROL: TECHNICAL, ECONOMIC AND LEGAL ASPECTS

McKnight, A. D., P. K. Marstand, and T. C. Sinclair (eds.). 1974.
London, George Allen & Unwin Ltd., 1974. 324 p.

The occurrence and control of marine, air, land, water and noise pollution are reviewed with special reference to legislation and social effects.

Economic effects of oil pollution, Social effects of oil pollution, International legislation

C-1064-76
ECOLOGICAL ANALYSIS OF HYPOTHETICAL OIL SPILLS OCCURRING IN THE NEARSHORE WATERS OF LONG ISLAND, NEW YORK

Moore, S. F., and B. P. Schrader. 1975.
Institute of Environmental Sciences, 21st, Mt. Prospect, Illinois, 1975. Vol. 1. Energy and the Environment. p. 55-63.

Physical-chemical recovery, population recovery and habitat recovery are discrete aspects of the recovery of a coastal zone ecosystem from oil spill disruption. Several factors governing the weathering, degradation and incorporation of oil for a locality are discussed. Stages of population recovery are identified and defined in terms of prespill population densities. Steps in the recovery of a habitat are outlined for a "worst-case" spill. Hypothetical oil spill scenarios are developed, characterized by oil composition and amount, season, impact zone, habitat and many other variables; such scenarios serve as analytical models.

General fate of oil in the environment, Biological effects of oil pollution

C-1065-76
SOME ENVIRONMENTAL PROBLEMS AND THEIR SATELLITE MONITORING

Otterman, J. 1975.
British Interplanetary Society, Journal 28:613-623.

Man-induced change of the earth's surface is examined in two problem areas: land use changes, overgrazing and their effects on albedo and land surface-atmosphere interactions; and water and land surface pollution, especially oil slicks. The need for monitoring is emphasized. It is suggested that the ERTS (Landsat) series satellites can provide approximate monitoring information.

Monitoring

C-1066-76
ENVIRONMENTAL EFFECTS OF ENERGY PRODUCTION

Singer, S. F. 1975.
The Changing Global Environment. S. F. Singer (ed.). Dordrecht, Netherlands, Reidel, 1975. p. 25-44.

This review covers fossil fuels and their environmental effects, nuclear energy and thermal environmental effects.

C-1067-76
POLLUTION OF THE SEAS

Unknown. 1974.
Environmental Pollution Control: Technical, Economic and Legal Aspects. A. D. McKnight, and P. K. Marstrand (eds.). London, Allen and Unwin, 1974. p. 150-173.

This chapter of the book is concerned with sources and types of marine pollution. Effects and cleanup measures for such pollutants as oil, halogen hydrocarbons, organic waste, inert solids and inorganic and radioactive wastes are discussed.

Cleanup and recovery

C-1068-76
WARREN SPRINGS LABORATORY 1974

Warren Springs Laboratory. 1974.
Annual Review 1973-74. 36 p.

This review lists the work currently being undertaken in industrial and environmental technology. Studies include catalysis, control engineering, materials handling and recovery, minerals processing, oil and air pollution, refuse separation, and separation using ferrofluids. Published reports are listed.

C-79-76
ENVIRONMENTAL QUALITY

Willard, B. E. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop, National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.). NBS Special Publication No. 409. p. 15-18.

The author discusses seven basic ecological principles that must be adhered to if the ecosystems of the ocean are to be saved from the long-term, as yet unknown effects of oil pollution. The concepts reviewed concern the cycling of materials, limiting factors and carrying capacities of ecosystems, and the stability of diverse ecosystems.

C-1069-76
SIGNIFICANCE OF THE SOIL IN ENVIRONMENTAL QUALITY IMPROVEMENT

Zwerman, P. J., and F. A. M. DeHaan. 1973 (rec'd. 1974).
The Science of the Total Environment 2(2):121-155.

The impact of agriculture and industry on plant and animal ecosystems is indicated. The problems and control of excessive fertilizer nutrients, pesticides and agricultural chemicals including heavy metals are outlined. Oil spills as a pollutant on land are described in quantitative terms and remedial measures are presented.

D. EFFECTS OF OIL PROSPECTING AND PRODUCTION

1. BIOLOGICAL EFFECTS

C-1070-76
INDUSTRIAL HYGIENE ASPECTS OF HANDLING OF MINERAL OIL AND MINERAL OIL PRODUCTS [English summary]

Herrmann, H. 1975.
Compendium 74/75, Vortrage der Haupttagung der Deutschen Gesellschaft fuer Mineraloelwissenschaft Kohlenchemie, 24th, 1974. D. Klamann, F. Asinger, and H. Boigk (eds.). Leinfelden, Germany, Industrieverlag von Hernhaussen KG, 1975. 2:877-885.

"The review covers problems of preventing the carcinogenic effects of high-boiling aromatic oils, health hazards from oil mists, and the toxic effects of solvents, C_{12-14} n-paraffins, and cutting oils."

C-1071-76
DISCUSSING DRILLERS'SECOND BEST BREW

Ray, J. P. 1975.
Ecolibrium 4(4):13-15.

Drilling mud, an expensive complex mixture of natural minerals and man-made chemicals, is used to cool and lubricate the oil bit, stabilize well walls, and to counter high formation pressures. The average Gulf of Mexico well produces about 2 million pounds of drilling mud solids, forming a "cutting pile" of hard substrate for colonization by marine organisms. Studies are underway that will determine the effect that offshore platforms have had on marine life.

2. PHYSICAL EFFECTS

C-1072-76
CHANNEL EROSION SURVEYS ALONG SOUTHERN SEGMENT OF THE TAPS ROUTE, ALASKA, 1972 AND 1973

Childers, J. M. 1975.
Open-file report (basic data). 57 p.

Preconstruction conditions at selected stream-channel sites along the southern segment of the Trans-Alaska Pipeline System are described. This information facilitates the studies of severe channel erosion, streambed scour, bank erosion or rechannelization in this area.

General effects of oil prospecting and production

C-1073-76
No title given (news brief)

Novick, S. 1976.
Environment 18(2):24.

Alaskan offshore oil lease sales have been postponed. The White House CEQ and EPA have opposed offshore drilling on the north coast of Alaska because of the danger that oil spills could melt large areas of Arctic cover ice, setting off global climatic changes.

Physical effects of oil prospecting and production, Physical effects of oil pollution

3. SOCIAL EFFECTS

C-1074-76
ROLE OF CENTRAL AND LOCAL AUTHORITIES

McCrone, R. G. L. 1974.
Impact of Offshore Oil Operations, Aviemore, Scotland, 1974.
Barking, Essex, Applied Science Publishers, 1974. p. 145-156,
161-165. (Institute of Petroleum Summer Meeting)

North Sea oil development has been so fast that both central government and local authorities have received large amounts of additional work and have needed to reorganize. This paper explains how the machinery works from the viewpoint of the Scottish Office and outlines developments of concern to public authorities and public investment in Scotland.

Economic effects of oil prospecting and production

C-1075-76
OPERATORS POISED FOR BIG LEASE SALE OFF CALIFORNIA

Wilson, H. M. 1975.
The Oil and Gas Journal 73(49):23-25.

The political and technical issues surrounding the oil companies' plans to bid for offshore leases off the California coast on December, 1975, are described. This article also includes the oil companies' plans to form a new oil spill-cleanup cooperative. The cooperative will purchase equipment (skimmers, booms, aircraft, etc.) for quick deployment in emergencies.

Cleanup and recovery, Contingency planning

4. ECONOMIC EFFECTS

C-1076-76
OIL CHANGING THE FACE OF SCOTLAND

Anon. 1974.
Northern Offshore 3(5):21-22, 25-26, 29.

The effects of offshore oil production on the economy of Aberdeen, and the Highlands and Islands regions are discussed. The oil production necessitates transport operations, training programs in the new technology, onshore supply services, etc. For Scotland, the job market has expanded and land allocations have changed.

Social effects of oil prospecting and production

C-1077-76
SCOTTISH MANUFACTURING INDUSTRY AND OFFSHORE OIL DEVELOPMENTS

Buyers, T. B. 1974.
Impact of Offshore Oil Operations, Aviemore, Scotland, 1974.
Barking, Essex, Applied Science Publishers, 1974. p. 65-81.
(Institute of Petroleum Summer Meeting)

The effect of North Sea oil development on Scottish industry is reviewed, with emphasis on the manufacturing industries associated with North Sea oil. The west and west-central areas are also experiencing expansion, especially in the manufacture of production equipment. The main areas of manufacturing activity are exploration production platforms and equipment, and general marine equipment.

C-1078-76
THE OCS (OUTER CONTINENTAL SHELF) PETROLEUM PIE

Devanney, J. W. 1975.
Final report, MITSG-75-10, COM-75-10599, NOAA-75041105. 132 p.

The management alternatives for OCS petroleum are analyzed. The economic costs associated with the OCS are large. Alternatives include work obligation permitting, bonus bidding, royalty bidding, profits bidding, and public exploratory drilling followed by bonus bidding. This last option is examined in detail.

C-1079-76
IMPLICATIONS FOR THE ECONOMY

Gaskin, M. 1974.
Impact of Offshore Oil Operations, Aviemore, Scotland, 1974.
Barking, Essex, Applied Science Publishers, 1974. p. 83-103.
(Institute of Petroleum Summer Meeting)

Scotland is gaining both employment and income from North Sea oil production. Offshore operations are introducing activities, skills and technologies either directly or indirectly into the economy.

C-1080-76
OFFSHORE PETROLEUM AND NEW ENGLAND: A STUDY OF THE REGIONAL ECONOMIC CONSEQUENCES OF POTENTIAL OFFSHORE OIL AND GAS DEVELOPMENT

Grigalunas, T. A. 1975.
University of Rhode Island, Marine Technical Report 39. 121 p.

The impacts of various Georges Bank oil and gas development plans and petroleum refinery sites on the total earnings, income and employment and population of New England are discussed. An estimate is also made of the direct and secondary impact of various plans for petroleum development on industrial aspects of the regional economy.

Social effects of oil prospecting and production

C-1081-76
SCOTLAND AND OIL

Hutchison, A. M., and A. Hogg. 1975.
Edinburgh, Scotland, Oliver & Boyd, 1975. 125 p.

The growth of the Scottish oil industry is reviewed. The socio-economic implications of this fast growth in oil exploration are well covered.

Social effects of oil prospecting and production

5. GENERAL EFFECTS

C-1082-76
NORTH SEA OIL DEVELOPMENT: SOME RELATED ENVIRONMENTAL AND PLANNING CONSIDERATIONS IN SCOTLAND

Affolter, M. T. 1976.
Ambio 5(1):3-16.

The main ecological and planning responses to oil-related development of offshore Scotland are presented. Its impact on the mainland and islands of Scotland is discussed.

C-1083-76
OIL AND THE OUTER CONTINENTAL SHELF: THE GEORGES BANK CASE

Ahern, W. R., Jr. 1975.
Cambridge, Massachusetts, Ballinger, Publishing Co., 1975. 164 p.

The feasibility and potential effects of oil and gas development on the Georges Bank, a rich fishery off Cape Cod, are analyzed. Risks to the environment from drilling, uses of deep-water ports, tankers, the possibilities of oil spills, costs, and technological and geological problems of offshore drilling are topics examined.

C-1084-76
No title given (news brief)

Anon. 1976.
Audubon 78(2):130.

Both state and Canadian officials have expressed concern over the proposed oil and gas bids on the Atlantic Shelf. The Governors of New Jersey and Massachusetts have specific complaints. The Canadian government claims some of the Georges Bank territory that has been set aside for drilling.

C-1085-76
No title given (news brief)

Anon. 1976.
Ocean Oil Weekly Report 10(19):1.

Support for the Mid-Atlantic Offshore lease sale came from unexpected sources. The Governor of New Jersey urged rapid and full exploration of the Baltimore Canyon, but opposed refinery construction near the beaches. The AFL-CIO also urged development. Pipeline construction plans may create more opposition, however.

Economic effects of oil prospecting and production

C-1086-76
No title given (news brief)

Anon. 1976.
Petroleum Engineer International 47(7):EM4.

Both Maine and Oregon have recently approved oil refinery sites. The Maine site at Eastport may still be challenged by Canada, due to a concern about oil spill damage to fish. The Oregon site is near Portland. Both refineries need more government permits to operate.

C-1087-76
No title given (news brief)

Anon. 1976.
Petroleum Engineer International 48(2):1.

The EPA feels the environmental impact statement for the oil and gas lease sale in the Gulf of Alaska is inadequate. The sale could be delayed as much as a year.

C-1088-76
ALASKA LEASE DECISION DELAYED (news brief)

Anon. 1976.
The Oil and Gas Journal 74(5):47.

The Council on Environmental Quality is requesting a delay of the sale of Alaskan Gulf leases or at least a limitation of the sale to the 19 Icy Bay tracts. According to CEQ, the potentially affected Alaskan communities will need 1-2 years to prepare for onshore impacts of offshore production. The EPA has also urged a 2 or 3-year delay in order to complete current environmental studies.

C-1089-76
THE ASSESSMENT OF FEASIBILITY: AN OVERVIEW

Anon. 1974.
Pacific Northwest Sea 7(3-4):3-7.

The study assesses the feasibilities of 13 deepwater port alternatives in terms of engineering, economic, social, jurisdictional, and environmental implications. Both dollar costs and spill projections are discussed. An offshore petroleum transfer system is not feasible along the Pacific coast or off Anacortes. A monobuoy system west of Port Angeles and a deepwater fixed terminal at one or several places are examined.

Economic effects of oil prospecting and production

C-1090-76
CHANCE OF BEAUFORT SEA OIL SPILL SEEN REMOTE (news brief)

Anon. 1976.
The Oil and Gas Journal 74(5):35.

A report by Canada's Federal Environment Department on a drilling project planned for the Beaufort Sea the summer of 1976 states that only an undersea oil blowout would cause a major environmental impact. The chances are only 1 in 5,000-10,000 that this will occur. But, control and cleanup would be difficult due to the ice and weather conditions, and damage to birds could be large.

Cleanup and recovery, Biological effects of oil pollution

C-1091-76
CONFERENCE ON ENVIRONMENTAL ASPECTS OF CHEMICAL USE IN WELL-DRILLING OPERATIONS, HOUSTON, 1975

Anon. 1975.
EPA/560/1-75/004, Contract EPA-68-01-2928. 582 p.

The following topics are included: techniques and chemicals used in well drilling, toxicity of chemical additives in drilling muds, potential toxic effects of chemical additives on the environment, environmental impact of chemicals used in well drilling, contamination and transport of additives in ground water, and environmental impact of the byproducts in well drilling.

Biological effects of oil prospecting and production

C-1092-76
DEEPWATER PORTS SEEN CUTTING OIL IMPORT COSTS, CONGESTION

Anon. 1975.
Commerce Today 5(11):5-6.

Deepwater ports may now be built in U.S. waters. Deepwater ports could reduce oil shipping costs by 40%, resulting in a $1.5 billion annual reduction in U.S. energy costs. Spillage risks from collision, groundings or oil transfer operations will be minimized by supertankers. The construction and operation of the deepwater ports will be regulated by the Department of Transportation.

Oil transfer and transport

C-1093-76
ENVIRONMENTAL ASSESSMENT PROGRAM OF ALASKA'S OUTER CONTINENTAL SHELF

Anon. 1975.
Environmental Technology and Economics No. 23:5-6.

Beginning in the spring of 1976, the environmental assessment program for Alaska will include the Northern Bering and Chukchi Seas and the Lower Cook Inlet. The research is directed toward an assessment of physical transport processes and physiological and ecological effects of petroleum-related pollutants. Six task statements are included in this Request for Proposals.

Biological effects of oil pollution

C-1094-76
FACT SHEET ON DEEPWATER PORTS

Anon. 1974.
Washington, D.C., Federal Energy Administration, 1974. 3 p.

The U.S. does not have ports deep enough to accommodate supertankers. The economic and environmental costs of existing dredging ports are prohibitive. Single buoy mooring offshore with a swivel to allow the ship to "weathervane" appears the most feasible design.

Economic effects of oil prospecting and production, Oil transfer and transport

C-1095-76
OCEANOLOGY INTERNATIONAL 75 'INTO DEEPER WATERS'

Anon. 1975.
Conference, Brighton, U.K., 1975. London, BPS Exhibitions,
1975. 437 p.

The conference papers are grouped by main subject. These include national reports, oil and gas, minerals, fisheries technology, and environmental sciences.

C-1096-76
OFFSHORE OIL (news brief)

Anon. 1975.
Alaska Seas and Coast 3(4):4-5.

Aspects of the federal program to lease Alaskan OCS are briefly covered. Public conferences, environmental impact statements, jurisdictional decisions and the present status of Kachemak Bay are topics included.

C-1097-76
OFFSHORE OIL (news brief)

Anon. 1975.
Alaska Seas and Coasts 3(5):6.

Fishermen will be entering "negative nominations" for the Kodiak area to the Department of Interior. The significant fishing areas will be documented by both fishermen's groups and government organizations. Life history factors such as breeding grounds and migratory routes will also be determined.

Economic effects of oil prospecting and production

C-1098-76
OIL AND GAS DEVELOPMENT IN THE SANTA BARBARA CHANNEL OUTER CONTINENTAL SHELF OFF CALIFORNIA

Anon. 1975.
U.S. Geological Survey, Draft Environmental Statement, DES75-35,
Vol. 1-3, 715 p.

Four different levels of oil and gas leasing in the channel are considered, from maintaining the status quo to developing unleased areas. The reserves in the Santa Barbara Channel contain 1-2 billion barrels of oil. The pollution risks to the marine organisms and the shorelines, and concern over accidental or recurrent spillage are discussed.

Biological effects of oil pollution, Physical effects of oil pollution

C-1099-76
OIL BARRED FROM N.E. COAST AS DRILLING STARTS

Anon. 1976.
National Fisherman 56(9):25-A.

Oil drilling has been banned within 50 miles of the shore because of the increased chances that the oil will reach the beach, and the potential disturbance to the lobster fishery or the tourist industry. Onshore impacts of offshore production are beginning in Rhode Island and causing concern in Delaware, Maryland, and Virginia.

Economic effects of oil prospecting and production

C-1100-76
OIL SHALE

Anon. 1974.
Report from Project Independence. Washington, D.C., Federal Energy Administration, 1974.

The development of oil shale resources as a new source of energy is discussed. Workable methods for recovering oil from oil shale and the environmental impact problem in mining oil shale are described.

C-1101-76
OPPOSITION LIGHT AT IMPACT HEARING

Anon. 1976.
Offshore 36(3):192-193.

The proposed mid-Atlantic offshore lease sale in May received little opposition during the environmental impact hearings. Officials were not critical, and the AFL-CIO called for immediate development. Studies indicate pollution risks from foreign tankers and transfer points are greater than from Atlantic OCS exploration.

C-1102-76
POLITICS AND POLLUTION STILL DOMINATE THE AUSTRALIAN OIL SCENE

Anon. 1975.
Petroleum Times 79(2011):69, 73, 75, 77.

According to Australian industrialist I. McLennan, policies of the Australian government have inhibited the development of mining and petroleum industries. Some of the latest moves on the political front and conclusions of a royal commission which has been looking at prospects of drilling on the Great Barrier Reef are discussed.

C-1103-76
PROPOSED INCREASE IN ACREAGE TO BE OFFERED FOR OIL AND GAS LEASING ON THE OUTER CONTINENTAL SHELF: DRAFT ENVIRONMENTAL STATEMENT

Anon. 1974.
U.S. Bureau of Land Management, Report DES74-90. Vol. 1, 801 p.

A proposal to lease 10 million acres for OCS oil and gas exploration in 1975 would involve leasing in frontier areas. The potential environmental impacts of development and alternative leasing, bidding, management and technology systems are discussed.

Economic effects of oil prospecting and production

C-1104-76
PROPOSED INCREASE IN ACREAGE TO BE OFFERED FOR OIL AND GAS LEASING ON THE OUTER CONTINENTAL SHELF: DRAFT ENVIRONMENTAL STATEMENT

Anon. 1974.
U.S. Bureau of Land Management, Report DES74-90. Vol. 2, 615 p.

The environmental impacts of the proposed increase in leasing would be on the nearshore and coastal zone, water quality, commercial fisheries, ship traffic and navigation, and mineral resources. Damage to marine organisms, wetlands and beaches is unavoidable. Local short-term use and long-term productivity are analyzed.

Biological effects of oil prospecting and production, Economic effects of oil prospecting and production

C-1105-76
REPORT FROM THE FISHERIES AND OFFSHORE OIL CONSULTATIVE GROUP

Anon. 1975.
Department of Agriculture and Fisheries for Scotland (Edinburgh).
9 p.

The Group was established for the purpose of exchange of information on matters concerning the fishing and oil industries and developments in offshore oil and gas exploitation. Topics covered in the report include navigation questions, laying of buoys, navigation of vessels, oil-related debris, pipelines, underwater installations, and long-term effects of offshore oil on the fishing industry.

Economic effects of oil prospecting and production, Oil transfer and transport

C-1106-76
SANTA BARBARA HAS BIG OIL POTENTIAL, SAYS INTERIOR

Anon. 1975.
Offshore 35(10):79-81.

Interior's three-volume draft environmental statement examines the impacts of 4 potential levels of further development in the Channel. The statement considers offshore operations to have improved since the 1969 spill that caused development to halt. If all four options are exercised, additional platforms, 1-5 offshore facilities, 0-21 submerged production systems, 1-6 pipelines, and 239-685 wells will be necessary.

C-1107-76
TO DRILL OR NOT TO DRILL (news brief)

Anon. 1976.
Environmental Action 7(17):14.

The latest developments in offshore drilling in California, New England and Alaska are briefly reviewed. The Interior Department has warned that oil spills off the Atlantic coast could hurt the tourist and fishing industries; onshore development would destroy beach and marshland. The EPA has asked that Alaskan OCS development be postponed indefinitely.

Biological effects of oil prospecting and production, Economic effects of oil prospecting and production

C-1108-76
A WESTERN REGIONAL ENERGY DEVELOPMENT STUDY: PRIMARY ENVIRONMENTAL IMPACTS. VOLUME I, II, EXECUTIVE SUMMARY

Anon. 1975.
Final report, RC-100-064-Vol-1 EQ-4AC037-Vol-1, RC-100-064-Vol-2
EQ-4AC037-Vol-2, RC-100-064-ES EQ-4AC037-ES. 193 p, 771 p., 60 p.
[PB-246 264/6GA, PB-246 265/3GA, PB-246 267/9GA]

This report examines the environmental impacts of the development of 38 energy resources, including crude oil and oil shale sources in the western U.S. Air and water emissions, solid waste, and land requirements of a plant or process are topics considered.

C-1109-76
A WESTERN REGIONAL ENERGY DEVELOPMENT STUDY: PRIMARY ENVIRONMENTAL IMPACTS. APPENDICES

Anon. 1975.
Final report, RC-100-064-APP EQ-4AC037-App. 191 p. [PB-246 266/1GA]

Water availability and air pollution and water pollution regulations are discussed.

Industry standards and guidelines

C-1110-76
ECOLOGY AND OFFSHORE OIL

Bachman, W. A. 1975.
The Oil and Gas Journal 73(40):61.

A scientific study was coordinated by the Gulf Universities Research Consortium to assess the ecological effects of offshore oil drilling and production in Timbalier Bay off New Orleans. Data indicate that "concentrations of all compounds which are in any way related to drilling or production are sufficiently low to prevent any known persistent biological hazards."

Biological effects of oil prospecting and production

C-1111-76
A BRIEF ANALYSIS OF THE IMPACT OF ENVIRONMENTAL LAWS ON ENERGY DEMAND AND SUPPLY

[illegible], [illegible], and [illegible]. 1976.
[illegible], Contract [illegible]. 130 p.
[illegible]

This report examines 10 key environmental issues, quantifies the energy impact of each of the issues, and evaluates the relative importance of the impacts. Descriptor words include refineries, crude oil, and petroleum pipelines.

C-1112-76

OFFSHORE INDUSTRIAL-PORT ISLANDS

Biggs, R. B. 1975.
Oceanus 19(1):57-66.

The feasibility of constructing multipurpose industrial port islands suitable for petroleum refineries, deepwater terminals, petrochemical plants, electric power plants, facilities for LNG, etc., is considered from economic, environmental, and legal jurisdictional viewpoints. The environmental problems could be eased if a program-oriented environmental impact statement were developed.

Oil transfer and transport

C-1113-76

ENERGY AND THE ENVIRONMENT

Biswas, A. K., and F. K. Hare. 1974.
World Energy Conference, 9th, Detroit, 1974.

The effects of man's search for energy sources and energy production on the environment are discussed. Potential pollutant hazards from coal, oil, natural gas, nuclear fuels and hydropower are shown in matrix form.

C-1114-76

ENVIRONMENT, DEVELOPMENT, AND THE NATIONAL INTEREST: PROBLEMS IN DEFINITION AND PREROGATIVES

Bockrath, J. 1975.
Natural Resources Lawyer 8(1):29-43.

The federal rather than state government should control the planning and siting of deepwater ports. Environmental questions should be considered. The federal government is concerned with the best interests of the nation's population and is not limited by the self-interest of smaller political areas.

U.S. legislation, Oil transfer and transport

C-1115-76
OIL DRILLING IN THE BEAUFORT SEA: LEAVING IT TO LUCK AND TECHNOLOGY

Carter, L. J. 1976.
Science 191(4230):929-931.

Although the environmental impact statement on Canadian oil drilling in the Beaufort Sea is frank about the problems of drilling in an environment with such ice conditions and the massive losses that could occur with a blowout, drilling appears to be imminent. U.S. protests and Canadian Arctic Resources Committee protests are reviewed.

C-1116-76
USE OF A BIOASSAY TEST IN EVALUATING THE TOXICITY OF DRILLING FLUID ADDITIVES ON GALVESTON BAY SHRIMP

Chesser, B. G., and W. H. McKenzie. 1975.
Conference on Environmental Aspects of Chemical Use in Well Drilling Operations, Houston, 1975. 19 p.

Results of 96-hour salt-water toxicity tests with several common drilling fluid additives are given. The materials tested include hemlock bark extract, chrome treated lignosulfate, iron lignosulfate, non-water dispersible defoamer, low molecular weight polyacrylate, and cellulosic-calcium carbonate workover additive. The 50 percent toxicity level of brown or white shrimp is given for each additive.

Biological effects of oil prospecting and production

C-1117-76
GEOCHEMISTRY OF OIL FIELD WATERS

Collins, A. G. 1975
Amsterdam, Elsevier Scientific Publishing Co., 1975. 495 p.

Subsurface oilfield waters are related to the origin, migration and maturation of oil and gas. They are thus important to the exploration and production of oil and gas and to the protection of the environment. Several of the 16 chapters are concerned with disposal methods for oilfield waters and the environmental damage that occurs with faulty disposal.

Waste treatment and disposal methods

C-1118-76

TOTAL-NEW GRASS ROOTS PLANT FOR THE DUTCH

Cooper, D. J., and F. H. Fransen. 1975.
The Oil and Gas Journal 73(6):51-54.

Traditionally Dutch refineries have been located in the Rotterdam area. The Total Rattinaderij Nederland N.V. grass roots refinery, however, is on the north bank of the Schelde estuary. This allows the finished products to be shipped by barge throughout western Europe on the inland waterways system. The refinery and its environmental protection measures are described.

C-1119-76

EXPLORATORY DRILLING WELL CONTROL PRACTICES

Crockford, A. L., G. R. Gardner, and R. N. Worrall. 1975.
Petroleum and the Continental Shelf of North West Europe.
H. A. Cole (ed.). Barking, United Kingdom, Applied Science
Publishers, 1975. Vol. 2. Environmental Protection. p. 5-19.

The types of offshore drilling units in the North Sea, the exploratory drilling process, and the problem of well control are described. The sources of environmental contamination and their impact are reviewed. Unless unusual events occur, the effect of exploratory drilling on the North Sea will be very small.

C-1120-76

POLITICS AND REGIONAL COASTAL ZONE MANAGEMENT

Cuevas, D. J., L. W. Noonan, W. S. Henderson, J. Knowles, G. Blessey, and J. C. Mosely. 1974.
Gulf States Conference on Coastal Zone Management, Mississippi-
Alabama Sea Grant Consortium. MASGP-74-043. p. 49, 54-75.

The legislation permitting Alabama and Mississippi to receive a license for an offshore deep-water port in the Gulf of Mexico is discussed; Mississippi's role is detailed. Florida's and Texas's positions on offshore ports, offshore energy extraction, refinery sitings and land use are given. The problems caused by federal control of Louisiana wetlands are explained; it is recommended that elected officials give out the specific guidelines.

State legislation

C-1121-76
OFFSHORE OIL: TECHNOLOGY ... AND EMOTION

Emery, K. O. 1976.
Technology Review 78(4):31-37.

The United States faces a serious energy problem in which demand has outrun supply. The present energy supply is mainly from oil and gas followed by coal, nuclear reactors and hydropower. The continental shelves offer the best apparent chance for a fairly large immediate source of supplementary oil and gas. Tanker operations spill about 20 times as much oil annually as does oil production from world continental shelves; thus, environmentalists should favor increased oil production from U.S. shelves rather than tanker importation.

Oil transfer and transport

C-1122-76
ENVIRONMENTAL PROTECTION AND OFFSHORE TECHNOLOGY - EXPLORATION AND PRODUCTION [English summary]

Falkingham, D. H. 1975.
Erdöl und Kohle, Erdgas Petrochemie vereinigt mit Brennstoffchemie 28(11):511-519.

The environmental protection measures and the environmental impact of offshore operations are reviewed. Pros and cons of methods of controlling oil spills are considered. Possible future developments and their environmental advantages are mentioned. The industry's cooperative environmental activities are illustrated with examples from North Sea operations.

Cleanup and recovery

C-1123-76
ARCTIC PETROLEUM DEVELOPMENT: EMERGENT ISSUES

Fischer, D. W., and R. F. Keith. 1975.
Marine Technology Society Journal 9(10):23-31.

Studies have been commissioned by the Science Council of Canada to investigate the decision-making system and processes associated with petroleum development in the Mackenzie and Arctic Islands regions. The environmental, technological, economic, social and political issues which emerge from Arctic petroleum exploration and development are analyzed.

C-1124-76
SAFETY OF DEEPWATER PORTS IS OFFSET BY INHERENT EVILS

Foss, W. O. 1976.
National Fisherman 56(9):22A, 30A.

The Coast Guard has issued its final environmental impact statement on its deepwater port regulations. The three types of facilities are described. Adverse environmental impacts on commercial fishing, estuaries and wetlands, marine biota, and beaches are unavoidable, but will be minimized by the regulations.

Economic effects of oil prospecting and production, Oil transfer and transport, U.S. legislation

C-1125-76
ATLANTIC OFFSHORE OIL: THE NEED FOR PLANNING AND REGULATION

Friedman, J. M. 1975.
Oceanus 19(1):22-31.

The concern of Atlantic coastal states over the potential consequences of offshore oil development is discussed; predictions of onshore impacts on New England coastal states are included. Current planning for offshore oil operations is said to be hampered by poor federal-state relations. The Bureau of Land Management and the U.S. Geological Survey have been criticized for isolationist programs and inadequate regulations for offshore development.

C-1126-76
OIL SPILLS AND THE OFFSHORE OIL INDUSTRY

Fulleylove, R. J. 1975.
Offshore Europe 75 Conference, Aberdeen, Scotland, 1975.
Kingston-on-Thames, Surrey, United Kingdom, Spearhead Publications Limited. OE-75 239.1-239.7.

Potential causes of oil spills in the offshore industry, the behavior and fate, including weathering, of oil spilled in the marine environment, the effects of the oil offshore and nearshore, and the methods available for cleanup and their respective advantages are discussed. A contingency plan takes all these factors into account; the North Sea is used as an example. Financial responsibility for pollution costs has been accepted by the industry.

General fate of oil in the environment, Cleanup and recovery, Contingency planning

C-1127-76
OFFSHORE TECHNOLOGY, WHAT ARE THE LIMITS

Greer, R. L. 1976.
Petroleum Engineer International 48(1):21-30.

Problems and technological needs associated with offshore oil drilling, production, transportation and storage are considered. Exploratory drilling systems and fixed platform systems are described. Technology exists for environmental protection from oil spills in seas of 5 to 6-feet wave heights; but industry must advance its capability in handling spills in heavy seas and the Arctic.

Oil transfer and transport

C-1128-76
ENVIRONMENTAL ENHANCEMENT PROGRAM OF THE DIVISION OF OIL AND GAS IN THE SAN JOAQUIN VALLEY OIL FIELDS

Hill, F. L. 1975.
California Division of Oil Gas Technology Pap. Rep., No. TP01. p. 23-33.

A discussion of the environmental problems of the petroleum industry and environmental enhancement work in the San Joaquin Valley is given.

C-1129-76
NORTH SEA OIL AND GAS; IMPACT OF DEVELOPMENT ON THE COASTAL ZONE

Hollings, E. F., Chairperson. 1974.
National Ocean Policy Study. Washington, D.C., U.S. Government Printing Office, 1974. 177 p.

This report, prepared for the Senate Committee on Commerce, examines problems encountered and problem solving mechanisms applied by the United Kingdom in the present development of its oil and gas resources on the outer continental shelf of Scotland and the Shetland Islands. Included in the study is a brief assessment of the environmental impact and possible oil spill damage accompanying such development.

C-1130-76

COASTAL ZONE OIL IMPACTS

Howard, D. V. 1975.
Massachusetts Audubon 15(3):1-2.

Massachusetts needs some careful planning in order to deal with the onshore and environmental impacts of OCS development of Georges Bank. Stringent environmental regulations are needed to protect the valuable Georges Bank fishery. Liability and compensation for oil spills must be clarified. Onshore impacts due to development should be minimized.

Economic effects of oil prospecting and production, Social effects of oil prospecting and production

C-1131-76

FLOTTA OIL HANDLING TERMINAL: MARINE ENVIRONMENT PROTECTION

Howie, F., J. Read, and M. Turnball. 1975.
Petroleum Review 29(344):529-536.

The environmental protection program established for the Flotta oil handling terminal is discussed. Included are an environmental impact statement with the aim of designing sources of accidental oil release, procedures for the treatment of accidental oil releases and a monitoring program.

Contingency planning, Monitoring, Design and engineering

C-1132-76

ENVIRONMENTAL PROGRAM FOR A COMMERCIAL SHALE OIL COMPANY

Kilburn, P. D., and M. W. Legatski. 1974.
Minerals Symposium, 17th, Casper, Wyoming, 1974. New York, AIME.
p. 18-31.

The potential environmental impact of an oil shale complex designed to process 66,000 tons/day of oil shale was assessed by a $3 million program. The primary findings of the 113 studies, which were intended to minimize this impact, whether on air, water, wildlife or socio-economic conditions, are discussed.

Economic effects of oil prospecting and production, Biological effects of oil prospecting and production

C-1133-76

EARLY DEVELOPMENT OF ATLANTIC RESERVES ESSENTIAL

Klappenbach, E. S. 1975.
Chilton's Oil and Gas Energy 1(3):46-48.

The arguments and actions taken against developing East coast offshore oil production and the relevant rebuttals are reviewed. The questions posed include the possibility of another Santa Barbara, the aesthetics of oil rigs, damage to the fisheries, saving the oil for the future, and the onshore impact of the refinery workers. The author concludes that the delaying tactics must end and the reserves must be developed.

Economic effects of oil prospecting and production

C-1134-76

DECISION TO LEASE OUTER CONTINENTAL SHELF LANDS

Lee, H. 1975.
Coastal Zone Management Journal 2(1):31-46.

The present system for leasing parts of the OCS is analyzed. At this time the system limits the range of alternatives. The U.S. Department of Interior has shown some sensitivity to small-scale environmental and economic issues, such as oil spill prevention. But the big decisions on the optimal use of ocean and land resources are made independently of such issues.

U.S. legislation

C-1135-76

OFFSHORE OIL: SOME LEGAL CONSIDERATIONS

Linky, E. J. 1975.
Underwater Naturalist 9(2):8-11.

Legal and policy factors which show offshore development to be a threat to the Atlantic coast are analyzed. A brief explanation of the geological factors and production procedures demonstrates the danger of drilling. Legal remedies in the case of a spill are considered inadequate. New leasing procedures before Congress would solve some of these problems.

U.S. legislation

C-1136-76
EAST COAST EXPLORATION

Meyer, R. 1975.
Offshore 35(13):16.

Mr. Meyer, president of Exxon, U.S.A., discusses the issue of oil and gas resource development of the Atlantic outer continental shelf. He refers to studies of offshore areas where drilling operations have proceeded for decades. No evidence has been produced that these activities have had any adverse effect on the ecology.

Biological effects of oil prospecting and production

C-1137-76
BEAUFORT SEA AND MACKENZIE RIVER DELTA ENVIRONMENTAL STUDIES

Milne, A. R. 1975.
Canadian Society of Petroleum Geologists Memoirs, No. 4.
p. 821-827.

A description is given of the Beaufort Sea Project, the types of studies and their importance relative to offshore exploratory drilling. The program includes studies of wildlife, fisheries, baseline pollutants, physical oceanography, climatology, sea ice and oil spill detection and cleanup. The studies were to be completed by the end of 1975.

Cleanup and recovery

C-1138-76
AN ALASKAN JOURNAL

Morgan, A. H. 1975.
Massachusetts Audubon 15(1):3-6.

Two Audubon members were invited to tour the Alaskan pipeline and Prudhoe Bay to review construction progress, as well as measures taken to protect the environment. The efforts of the oil companies to avoid significant damage to the environment have been largely successful; the adverse impacts have been on the social structure of Alaska. Concern over tanker traffic was reinforced.

Social effects of oil prospecting and production

C-1139-76
MINERAL RESOURCES AND THE ENVIRONMENT

National Academy of Sciences. 1975.
Washington, D.C., National Research Council Committee on Mineral Resources and the Environment, 1975. 362 p.

This report studies the following issues: continued availability and efficient use of minerals and mineral resources, demand, supply, technology, and environmental impact of energy production.

C-1140-76
"PROGRESS" AND/OR BEAUTY

Power, C. 1975.
Cry California 10(3):3-12.

The Bantry Bay spill has focused Irish attention on environmental matters. The local government system is responsible for environmental protection. The South Coast of Ireland is developing rapidly, with applications for oil-rig platforms and refineries. Irish environmental-control methods are discussed in this context.

Foreign legislation

C-1141-76
THE ENVIRONMENT: PRESERVATION IS A PLUS

Rueth, N. 1975.
Mechanical Engineering 97(11):36-41.

The controversy surrounding the Alaska pipeline and oil development generated concern over the preservation of the environment and protection of the line and facilities from the ravages of Alaskan weather. The story of how these goals were achieved is given.

Oil transfer and transport

C-1142-76
DINNER ADDRESS [to the Gulf States Conference on Coastal Zone Management]

Schwartz, A. R. 1974.
Gulf States Conference on Coastal Zone Management, Mississippi-Alabama Sea Grant Consortium. MASG P-74-043. p. 99-103.

The environmental impact of OCS drilling in the Gulf of Mexico is discussed. A bill providing $200 million for policing the OCS is described; and the opinion is given that this money should be administered by the Office of Coastal Zone Management, not the Department of Interior. Hurricanes, offshore port facilities, ocean dumping, and coastal states' interactions are factors that must be covered by a good coastal zone management plan.

U.S. legislation

C-1143-76
PETROLEUM AND THE CONTINENTAL SHELF OF NORTH-WEST EUROPE. VOL. 2. ENVIRONMENTAL PROTECTION. H. A. COLE (ED.). BARKING, UK, APPLIED SCIENCE, 1975. 126 P. (NEW YORK, HALSTED, 1975)

Selwood, P. 1976.
Nature 259(5544):607-608.

In this review, objectives of the conference are outlined. The author comments on papers included in the following areas: the effect of oil pollution on the marine environment, indications of how the oil industry operates offshore during oilfield development and the safety precautions taken to prevent crude oil spillage.

General effects of oil pollution, Contingency planning

C-1144-76
OIL AND THE ENVIRONMENT - A CASE HISTORY

Spaulding, A. O. 1975.
Institute of Environmental Technology Meeting, 21st, Anaheim, 1975. Vol. 1:87-89.

The aim of this study is to point out that environmentally hazardous events resulting from spills from oil wells and platforms are exceptions rather than the rule. Oil well drilling and development may be conducted in the most delicate environment without seriously damaging the surroundings.

C-1145-76
THE STATE OF LOUISIANA SUPERPORT AUTHORITY ENVIRONMENTAL PROTECTION PLAN - OIL AND OYSTERS

Spencer, E. F., Jr. 1975.
Water Resources Bulletin 11(4):836-847.

The Deep Draft Harbor and Terminal Authority of Louisiana is supposed to develop a deepwater crude oil terminal and an environmental protection plan to preserve the unique coastal marshland. The status of both these plans are described.

C-1146-76

LOUISIANA SUPERPORT STUDIES: REPORT 3. RECOMMENDATIONS FOR THE ENVIRONMENTAL PROTECTION PLAN

Stone, J. H., et al. 1974.
Louisiana State University Center Wetland Resources Report, NTIS COM-75-10060. 547 p.

Data and recommendations are given for use in designing a regional plan for developing a superport. Information on the environment, site selection, superport design guidelines, authority funding, and the legal requirements of governmental agencies is included. Stresses that may result are oil spills, construction damage and ancillary development.

C-1147-76

DEEPWATER PORTS

U.S. Coast Guard. 1975.
Federal Register 40(89):19955-19978.

Regulations for the licensing, design, construction, equipment selection, and operation of deepwater ports beyond the U.S. territorial sea will prevent or minimize damage to the environment from deepwater port development. Pollution prevention, safety equipment and navigational aids are subject to standards set by these rules.

U.S. legislation, Oil transfer and transport

C-1148-76

OIL AND GAS DEVELOPMENT AND COASTAL ZONE MANAGEMENT

U.S. Senate Committee on Commerce. 1974.
U.S. 93rd Congress, 2d Session, 1974. Senate. Committee on Commerce. Hearings before National Ocean Policy Study. GPO-37-347. 454 p.

The environmental, economic and social impacts of OCS production on the coastal zone are discussed. Oil leasing, natural resources, oil drilling and oil exploration are among the topics discussed.

Economic effects of oil prospecting and production, Social effects of oil prospecting and production

C-1149-76
OUTER CONTINENTAL SHELF OIL AND GAS DEVELOPMENT AND THE COASTAL ZONE

U.S. Senate. Committee on Commerce. 1974.
GPO 39-356. 206 p.

Leasing of the outer continental shelf, and recommended improvements in procedures are discussed. Information needs, exploratory data, the environmental and socio-economic impact on the Coastal Zone, federal policies, technology and local control are among the topics reviewed.

Economic effects of oil prospecting and production

C-1150-76
ENVIRONMENTAL IMPACT OF FUTURE ENERGY SOURCES

Warren, F. H., and M. I. Goldman. 1974.
Chemical Engineering, Deskbook Issue. p. 47-51.

A review of future energy requirements/sources in the U.S. is given. The impact of coal, oil shale and nuclear power on land use and water supply is considered.

C-1151-76
OSC [sic] HEARINGS GENERATE PROFOUND STATEMENTS

Woodman, B. 1975.
Alaska Construction & Oil 16(3):16-18.

United States Department of Interior hearings on leasing millions of acres on the continental shelves drew comments from industry and non-industry people. The industry would like to lease parts of the Gulf of Alaska immediately, whereas others, including the governor of Alaska, are concerned over the lack of baseline data, the potential impact on the coastal zone, and the division of profits from the leasing.

Economic effects of oil prospecting and production

C-1152-76
ENVIRONMENTAL EFFECTS OF DRILLING MUDS AND CUTTINGS

Ray, J. R., and E. A. Shinn. 1975.
Conference on Environmental Aspects of Chemical Use in Well-Drilling Operations, Houston, 1975. 16 p.

Twelve samples taken around a drilling platform in 79.21 m (245 ft) of water were analyzed for alkalinity, total dissolved solids, total suspended solids, organic carbon and total chromium; the resulting values were compared with background values obtained from the literature. Variation was observed in total dissolved solids. Observations by divers of the dispersion of drilling cuttings by ocean currents and of the abundance of marine life around the platform are documented.

Biological effects of oil prospecting and production

C-1153-76
PETROLEUM IN THE ESTUARY

Rose, C. D. 1974.
University of Maryland, Natural Resources Institute Special Report No. 5, Contract No. 584. 15 p.

The construction and operation of petroleum refineries and support facilities in estuaries involve such high environmental risks that they appear unacceptable from an environmental viewpoint. A moratorium on all refinery construction in Maryland, until plans for siting and managing these facilities can be implemented, could minimize environmental risks and maximize potential economic gains.

Biological effects of oil prospecting and production

C-1154-76
CONFERENCE WORKSHOP TO REVIEW THE DRAFT STUDY PLAN FOR ENVIRONMENTAL ASSESSMENT OF THE GULF OF ALASKA, SOUTHEASTERN BERING AND BEAUFORT SEAS

Rosenberg, D. H. 1975.
Sea Grant-75-4 NOAA-75102102, Contract DI-088550-CT5-24, Grant NOAA-04-5-158-35. 195 p.

The topic areas covered include potential oil and gas development in the Arctic offshore and Gulf of Alaska, chemical and biological studies of an oil spill, interests and responsibilities of federal agencies, state policy regarding OCS environmental studies and recommendations for OCS study plan modifications.

Biological effects of oil pollution, Chemical effects of oil pollution, State legislation

C-1155-76
OIL SPILLS AND OFFSHORE PETROLEUM

Stewart, R. J. 1976.
Technology Review 78(4):47-59.

The author evaluates the possible consequences of oil spills from offshore production by examining individual aspects of the problem, such as sources of oil entering the marine environment, increased oil imports as an alternative to offshore production, the number and volume of oil spills, transport of oil by pipeline or by tanker, and spill trajectory behavior in regions of potential OCS development.

General fate of oil in the environment, Oil transfer and transport

C-1156-76
THE GEOLOGIST AND THE ENVIRONMENT

Williams, G. 1975.
Petroleum and the Continental Shelf of North West Europe.
H. A. Cole (ed.). United Kingdom, Applied Science Publishers,
Vol. 2. Environmental Protection. p. 1-2.

In the author's opinion, the geologist, with the help of the petroleum engineer, should play a leading and responsible role in environmental studies and should participate in decision making that could influence our environment. The reasons behind this opinion and aspects of handling environmental issues are discussed.

E. FATE OF OIL IN THE ENVIRONMENT

1. BIOLOGICAL DEGRADATION

C-1157-76
BACTERIOLOGICAL DISPERSANT FOR OIL SPILLS

Anon. 1975.
Marine Pollution Bulletin 6(12):178-179.

'Petrobac,' a bacterial product for cleaning up oil spills, has 3 components: a symbiotic mixture of hydrocarbon degrading microorganisms, nutrients, and biodegradable emulsifiers. The manufacturers claim that 'Petrobac' will clear 75% of a beach of oil in 3 weeks at 5-10°C. When used on open water, the system sinks the oil below the surface, and then biodegradation occurs.

C-1158-76
ECO NOTES - FOOD FOR THOUGHT (news brief)

Anon. 1975.
Environmental Action 7(12):8.

Ananda Chakrabarty has developed a "supermicrobe" that can digest most types of crude oil,converting it to harmless carbon dioxide and water. Previous microbiological methods have been slower than mechanical cleanup techniques, but this "bug" should be faster since it thrives on many hydrocarbons, rather than one or two.

Cleanup and recovery

C-1159-76
SEPARATION OF MICROORGANISMS FROM A CULTURE MEDIUM

Assmann, K., M. Tschernik, B. Voigt, W. Heike, and J. Krippenstapel. 1975.
German Offenlegungsschriften (unexamined patent application) 2,513,354

Microbial cells were separated from culture media containing petroleum distillates or diesel fuel as a C source by skimming off the water-insoluble phase. Then a surface active agent consisting of phosphatides (lecithins or cephalins), a lipid-hydrocarbon extract, or a water soluble protein was added. Normal separation procedures followed.

C-1160-76
MICROBIOLOGICAL DEGRADATION OF NORTHERN CRUDE OILS

Cook, F. D., and D. W. S. Westlake. 1974.
Environmental-Social Committee, Northern Pipelines, Task Force
on Northern Oil Development, Report No. 74-1. QS-1542-000-EE-A1.
Ottawa, Ontario, Information Canada, 1974. 127 p.

Field studies on the factors affecting the microbiological degradation of crude oil involved replicate oil soaked plots, some enriched with fertilizer and/or bacteria. Microbial and chemical analyses of the plots were made. Laboratory studies have shown that the chemical composition of oil, the quality of the oil, and temperature all affect the oil's biodegradability characteristics.

C-1161-76
PROCESS FOR THE ELIMINATION OF PETROLEUM RESIDUES BY BIODEGRADATION

Fusey, P. 1975.
Canadian Patent 980,026

The process eliminates petroleum residues by adding to the residues prescribed amounts of the following substances: vinasse, certain ammonium nitrates, sulfates and phosphates; certain alkaline and alkaline-earth phosphates and carbonates; and glue. This composition is then mixed with large amounts of water and the mixture is emulsified and aerated.

Cleanup and recovery, Waste treatment and disposal methods

C-1162-76
MICROBIAL DEGRADATION OF HYDROCARBONS

Gibson, D. T. 1975.
Phys. Chem. Sci. Res. Rep. 1 (Nat. Seawater, Report Dahlem
Workshop, 1975):667-696.

A review with 51 references of the microbial degradation pathways for single and mixed hydrocarbons and such compounds in crude oil.

C-1163-76
MICROBIAL INDICATORS OF OIL-RICH SALT MARSH SEDIMENTS

Hood, M. A., W. S. Bishop, Jr., F. W. Bishop, S. P. Meyers, and
T. Whelan III. 1975.
Applied Microbiology 30(6):982-987.

The validity of hydrocarbon-utilizing microorganisms as indicators of petroleum levels in the estuarine environment was examined.

The effects of hydrocarbons on the aerobic heterotrophic bacterial community within a marsh exposed to long-term oil contamination were studied. It is suggested that the presence of hydrocarbons alters the relative abundance of the most predominant aerobic heterotrophic bacteria.

Biological effects of oil pollution

C-1164-76

TREATMENT OF CELLS OF A HYDROCARBON-CONSUMING MICROORGANISM

Leavitt, R. I. 1975.
U.S. Patent 3,904,476

Ozone treatment removes contaminating hydrocarbon from cells grown in a liquid culture medium containing an aqueous mineral salt nutrient with a liquid hydrocarbon as a C source. The hydrocarbon is made soluble in aqueous liquids and the cells are killed. The cells are then removed from the aqueous solution.

C-1165-76

PETROLEUM-OXIDIZING BACTERIA ACCOMPANYING HIGHER AQUATIC PLANTS [English table of contents]

Morozov, N. V. 1974.
Biologicheskie Nauki 17(6):94-98.

The species of hydrocarbon-oxidizing bacteria accompanying two plants highly resistant to petroleum pollution (the bullrush, Scirpus lacustris, and narrowleaf cattail, Typha angustifolia) were investigated. The bacteria differed in species composition and in the ability to utilize various petroleum hydrocarbons as the sole carbon source.

C-1166-76

HYDROCARBON METABOLISM BY BREVIBACTERIUM ERYTHROGENES

Pirnik, M. P. 1975.
Dissertation Abstracts International, Section B 36(5):2079-B.

The mechanisms for biodegradation of normal or methyl branched alkanes by B. erythrogenes, which grows abundantly in mineral medium with crude oil as its sole carbon source, are presented.

Cleanup and recovery

C-1167-76
DEGRADATION OF PHENOLIC COMPOUNDS DOWNSTREAM FROM A PETROLEUM REFINERY COMPLEX

Polisois, G., A. Tessier, F. G. C. Campbell, and J. P. Villeneuve. 1975.
Journal of the Fisheries Research Board of Canada 32(11):2125-2131.

The concentration of phenolic substances in the river downstream from refinery outfalls in the region of Montreal East has been shown to diminish with distance from the outfalls. Results support the idea that biodegradation is responsible for the self-purification of phenolics in the St. Lawrence River.

Waste treatment and disposal methods

C-1168-76
EVALUATION OF PETROLEUM-DEGRADING POTENTIAL OF BACTERIA FROM WATER AND SEDIMENT

Walker, J. D., R. R. Colwell, and L. Petrakis. 1975.
Applied Microbiology 30(6):1036-1039.

Bacteria from water and sediment of an oil-polluted harbor were examined for ability to degrade petroleum. Water samples contained a larger variety of oil-degrading bacteria than sediment samples. These bacteria produced significantly greater degradation of several hydrocarbons than bacteria from the sediment.

Cleanup and recovery

C-1169-76
MICROBIAL DEGRADATION: APPLICATION OF COMPUTERIZED MASS SPECTROMETRY

Walker, J. D., R. R. Colwell, and L. Petrakis. 1975.
Canadian Journal of Microbiology 21(11):1760-1767.

The use of computerized low-resolution mass spectrometry is offered as a method for elucidating microbial degradation of petroleum. In this study, the degradation of a South Louisiana crude oil by a mixed culture of estuarine bacteria was evaluated using this procedure.

Analysis

C-1170-76

PETROLEUM HYDROCARBONS: DEGRADATION AND GROWTH POTENTIAL OF DEEP-SEA SEDIMENT BACTERIA

Walker, J. D., P. A. Seesman, T. L. Herbert, and R. R. Colwell.
1976.
Environmental Pollution 10(2):89-99.

Bacteria from Atlantic marine sediment samples were able to degrade petroleum hydrocarbons in a seawater based medium. The inorganic nutrient concentration from both the seawater and the sediment had a large effect on degradation. Those bacteria from deep-ocean stations were more successful at degradation than those from coastal sediments.

Cleanup and recovery

C-1171-76

INITIAL REACTIONS IN THE OXIDATION OF MONOCYCLIC AROMATIC HYDROCARBONS BY *PSEUDOMONAS PUTIDA*

Yeh, W.-K. 1975.
Dissertation Abstracts International B 36(2):591-592.

The initial reactions occurring during growth of *P. putida* on ethylbenzene and acetophenone are described. The enzyme system responsible for the initial oxygenation of certain monocyclic aromatic hydrocarbons was investigated; cells of *P. putida*, after growth on toluene, were used as an enzyme source. Results are given.

2. PHYSICAL CHANGES OF OIL

C-35-76
MOVEMENT OF SPILLED OIL IN SAN FRANCISCO BAY AS PREDICTED BY ESTUARINE NONTIDAL DRIFT

Conomos, T. J. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop, National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.). NBS Special Publication No. 409. p. 97-100.

For three years surface and seabed drifters were released every 2 months within San Francisco Bay and on the continental shelf of central California. One of the routine release sites was also the site of a major oil spill in January, 1971. Landward transport of the oil was predicted and confirmed by these studies. Oil that sank followed the path of the seabed drifters.

General fate of oil in the environment

C-1172-76
OIL SLICK FATE IN A REGION OF STRONG TIDAL CURRENTS

Drapeau, G., W. Harrison, W. Bien, and P. Leinonen. 1975.
International Coastal Engineering Conference, 14th, Copenhagen, Denmark, 1974. New York, ASCE. Vol. 3:2245-2259.

The drifting, spreading and aging of small oil slicks were studied in the St. Lawrence Estuary, an area which may be developed for supertankers. Recovery or dispersion of small spills in this region of strong tidal currents would be impossible. Since models do not predict oil motion well, the alternative is to construct slick-drift roses which will indicate shore areas where cleanup equipment may be needed.

General fate of oil in the environment

C-1173-76
RUNOFF OF OILS FROM RURAL ROADS TESTED TO SUPPRESS DUST

Freestone, F. J. 1974.
International Conference on Waste Oil Recovery and Reuse, Washington, D.C., 1974. Washington, D.C., Information Transfer, Inc. p. 375-393.

Two rural roads in Hunterdon County, New Jersey, which are oiled twice yearly with waste crankcase oils, were examined to determine whether oil leaves the roads. Oil may leave the road during wet weather by flotation from wet road surface material; lead in the waste oil also leaves by runoff. The ecological consequences of oil and lead runoff need further study.

General effects of oil pollution

C-1174-76
SURFACE ACTIVITY OF PETROLEUM AND ITS INFLUENCE ON THE SPREADING AND WEATHERING OF OIL FILMS AT SEA

Garrett, W. D. 1974.
Journal de Recherches Atmospheriques 8(3-4):555-562.

The spreading of petroleum products at the air-sea interface is enhanced by the polar surfactants (S) of the petroleum. A hydrophil balance was used to measure surface film areas to provide a semiquantitative determination of the polar S in petroleum products. Polar S enhance weathering at sea by causing the oil to spread into thin films.

C-1175-76
DYE AND DROGUE STUDIES OF SPOIL DISPOSAL AND OIL DISPERSION

Klemas, V., D. Maurer, W. Leathem, P. Kinner, and W. Treasure. 1974.
University of Delaware, Sea Grant Project, DEL-SG-15-74. 9 p.

Dye slicks and drogues can be tracked by aircraft-boat teams in order to assess surface and subsurface current circulation. In Cape Henlopen it was predicted that the tides would carry clay or oil slicks in and out of the bay along the main flow axis. Dye-drogue techniques contradicted the prediction by showing that the currents would move pollutants toward Delaware's Atlantic beaches.

C-1176-76
INCREASE IN THE CONTAMINATION WITH PETROLEUM PRODUCTS IN ROCKS AND SUBSURFACE WATER

Pelikan, V. 1975.
Geologicke Prace, Spravy 62:227-233.

In order to protect ground waters from oil pollution, the spreading characteristics of oil products must be known. A summary is given on the flow of oil-products in rocks and the spreading characteristics. Case histories involving pumping oil products away from the rock are given.

Chemical effects of oil pollution

C-1177-76

OFFSHORE APPLICATIONS OF MODELING TECHNIQUES. PT. 2. MODELS OF OIL SPILL DRIFTING

Stewart, R. J., and J. O. Willums. 1975.
Northern Offshore 4(10):#43-44.

Part 1 of this series considered possible ways to model the weathering and spreading of oil spills. In Part 2, the authors review how well the drifting paths of oil slicks and their components can be simulated. One of the results obtained from computer simulations is that the probability of a Georges Bank spill coming ashore in New England is variable, ranging from nil in the winter to 5% in the summer.

General fate of oil in the environment

3. GENERAL FATE OF OIL

C-1178-76
SEASONAL MEAN TRANSPORT OF HYPOTHETICAL OIL SLICKS IN SOUTHERN CALIFORNIA WATERS

Adamo, L. C., and C. M. Love. 1975.
Institute of Environmental Science, 21st, Mt. Prospect, Illinois, 1975. Vol. 1. Energy and the Environment. p. 49-54.

Seasonal charts of potential trajectories of hypothetical oil slicks were generated for the federal lease-sale program area of offshore southern California. Preexisting theoretical and empirical results were applied to available mean wind and mean current data. The charts indicate general directions of drift and variations in speed and direction of oil slick movement.

C-1179-76
HYDROGEOLOGICAL FACTORS IN GROUNDWATER POLLUTION

Blair, A. H. 1974.
Groundwater Pollution in Europe. J. A. Cole (ed.), Conference of the Water Research Association, Reading, England, 1972. p. 30-66.

Sources of groundwater pollution are identified and discussed. Oil pollution, for example, is governed by a complicated set of transport mechanisms and chemical reactions. The hydrogeologic factors that control the occurrence and movement of groundwater and pollutants are explained. The responsibility of preventing pollution lies jointly with the engineer, hydrogeologist, chemist and biologist.

C-1180-76
OIL SPILL TRAJECTORY STUDIES FOR ATLANTIC COAST AND GULF OF ALASKA

DeVanney, J. W., R. J. Stewart, and W. Briggs. 1974.
Massachusetts Institute of Technology, Technological Report No. MITSG 74-20. p. 213-403.

Analyses are given, based on a simple computer model, of the behavior of oil spill trajectories from a number of potential offshore production regions in the Atlantic and Gulf of Alaska, and from three potential nearshore terminal areas (Buzzards Bay, Delaware Bay, and Charleston Harbor). The probability of a spill coming ashore, the time to shore, and the wind conditions at the time the spill reaches shore were important factors.

C-1181-76
RANDOM MODEL OF EVAPORATION OF OIL AT SEA

Fallah-Araghi, M. H., and R. M. Stark. 1976.
The Science of the Total Environment 5(1):95-109.

The effect of a random environment on the oil evaporation process is studied. A random model is developed to predict the residual volume of oil as a function of elapsed time, initial oil volume and its physical properties, and random environmental factors. An applied example of the model is given.

C-1182-76
RANDOM MODELS OF SPILLED OIL MOVEMENT

Fallah-Araghi, M. H. 1975.
Dissertation Abstracts International, Section B 36(5):2380-B.

This study focuses on modeling the dominant modes of movement of spilled oil in an uncontrolled environment. A semi-empirical modeling approach with provision for describing tactical effects of random environmental influences is suggested. The dominant modes of movement, i.e., drift, evaporation, diffusion, are examined using this approach.

C-1183-76
OIL SPREADING ON COASTAL WATERS

Kim, Y. C. 1975.
International Coastal Engineering Conference, 14th, Copenhagen, Denmark, 1974. New York, ASCE. Vol. 3:2260-2267.

A model for predicting the spread of oil on coastal waters was developed. The Reynolds, Froude and Weber numbers and their relationship to the slick, and the influence of wind, currents, and waves on the spread area were studied. The effects of changes in water depth and the net spreading coefficient were investigated. Field and laboratory data were compared.

Physical changes of oil in the environment

C-1184-76
COMPUTER SIMULATION OF POLLUTION FRONT MOVEMENT

Sauty, J. P. 1974.
Groundwater Pollution in Europe. J. A. Cole (ed.), Conference of the Water Research Association, Reading, England, 1972. p. 68-85.

The movement of a pollution front in an aquifer is computed. One application of this calculation is the estimation of the natural delays which will occur while protection measures for the aquifer are being activated. The mathematical appendix contains all equations, assumptions and hypotheses.

C-1185-76
OFFSHORE APPLICATIONS OF MODELING TECHNIQUES. PT. 1. MODELS FOR WEATHERING AND SPREADING OF OIL SPILLS

Stewart, R. J., and J. O. Willums. 1975.
Northern Offshore 4(9):50, 53-54, 57.

In this series, mathematical modeling techniques available to solve problems in the offshore field will be presented. Part one deals with models having environmental questions. Discussed are oil spill characteristics, weathering and spreading.

Physical changes of oil in the environment

C-1186-76
NUMERICAL SIMULATION OF OIL SLICK TRANSPORT IN BAYS

Wang, S., and L.-S. Hwang. 1975.
International Coastal Engineering Conference, 14th, Copenhagen, Denmark, 1974. New York, ASCE. Vol. 3:2227-2244.

Oil spreading and transport can be predicted with the use of a simulation model. The spreading of the oil is superimposed on the drift motion caused by winds and tidal currents. The model is able to predict oil size, shape and movement as a function of time. Cardboard markers or soybean oil were used in field experiments in Long Beach Harbor. Computer predictions agreed with field traces.

C-1187-76
THE DISTRIBUTION OF OIL AND BEHAVIOR OF OIL SPILLS

Wardley-Smith, J. 1975.
Petroleum and the Continental Shelf of North West Europe.
H. A. Cole (ed.). United Kingdom, Applied Science Publishers, 1975. Vol. 2. Environmental Protection. p. 65-71.

The sources of oil in the marine environment, the size of spills to be dealt with and the fate of oil left on the surface are topics considered. Oil evaporation, photochemical oxidation, solution, dispersion and microbiological degradation are mentioned.

Source identification, Cleanup and recovery

F. OIL POLLUTION REGULATIONS

1. STATE LEGISLATION

C-1188-76
LAW, REGULATIONS AND GUIDELINES FOR THE HANDLING OF HAZARDOUS WASTE

California Department of Health. 1975.
California Department of Health. 77 p.

"Details of the code of practice for California, USA. Lists of hazardous materials, notification procedures, wastes classification systems are given."

C-1189-76
HAZARDOUS WASTES - ONE STATE'S EXPERIENCE

Collins, H. 1975.
Solid Wastes Management/Refuse Removal Journal 18(8):36, 38, 57.

About 35-60% of the annual wastes produced by California's manufacturing, chemical and petroleum industries are classified as hazardous to extremely hazardous, and their disposal is subject to new state legislation. The article briefly reviews and discusses the new regulations adopted by California Department of Health (Section 25100 et seq. Health and Safety Code) in light of the state's experience with these new regulations and guidelines.

Waste treatment and disposal methods, Industry standards and guidelines

C-1190-76
THE ROLE OF NORTH CAROLINA IN REGULATING OFFSHORE PETROLEUM DEVELOPMENT

Kilpatrick, J. E. 1975.
North Carolina Sea Grant Publication, UNC-SG-75-09. 32 p.

The legal framework--international, federal and state--for regulating offshore petroleum development is detailed. The historical conflict between federal and state governments over control of the seabed further than 3 miles from shore is reviewed. The pertinent federal legislation and North Carolina legislation are analyzed.

U.S. legislation

2. U.S. LEGISLATION

C-1191-76
No title given (news brief)

Anon. 1976.
Audubon 78(2):144.

The 94th Congress will consider amendments to the Coastal Zone Act. The additions would give guidelines and financial assistance to states to aid in abating pollution, congestion and destruction of critical coastline and estuarine ecosystems. The amendments originated from concern about onshore impacts of OCS development.

General effects of oil prospecting and production

C-1192-76
No title given (news brief)

Anon. 1976.
The Oil and Gas Journal 74(4):6.

The industry expects that Congress will delay water-pollution-control standards due to become law in 1983. The House Ways and Means Committee is considering ways to ease the financial burden of installing anti-pollution equipment.

C-1193-76
DEEPWATER PORT ACT OF 1974

Anon. 1974.
U.S. Senate. Committees on Commerce, Interior and Insular Affairs and Public Worsk. Report no. 93-1217. 106 p.

The Deepwater Port Act establishes a licensing and regulatory program governing offshore deepwater port development beyond the territorial limits and off the coast of the U.S. The use of deepwater ports will decrease tanker traffic in congested areas and reduce oil pollution damage. The Committees' report recommends enactment of the Act and contairs background information, major issues and cost considerations.

Oil transfer and transport, General effects of oil prospecting and production

C-1194-76
DELAY OF TOUGHER WATER-POLLUTION CODES URGED

Anon. 1976.
The Oil and Gas Journal 74(4):94.

The industry recommends that Congress delay stricter water-pollution control until the municipalities are able to meet 1977 standards. Then any necessary further improvement in water quality can be determined. The costs of further treatment would be "excessive for the marginal benefits that would accrue to the environment," according to an industry spokesman.

Waste treatment and disposal techniques

C-1195-76
HIGH SEAS OIL PORT ACT

Anon. 1974.
U.S. Congress, 93d, 1st Session. House of Representatives. Committee on Merchant Marine and Fisheries. Hearings and report. 40 p.

The High Seas Oil Port Act authorizes the issuance of licenses to eligible applicants for the construction and operation of high seas oil ports offshore. Procedures minimizing adverse environmental impacts will be mandatory. Authorizations for construction will be given by the Secretary of the Interior; the Coast Guard will be responsible for enforcing port operation regulations.

General effects of oil prospecting and production, Oil transfer and transport

C-1196-76
MAGNUSON ARGUES AGAINST COAST GUARD'S PROPOSED RULING (news brief)

Anon. 1976.
Sea Technology 17(1):37.

The USCG's proposed rules to make vessels carrying polluting substances in bulk less likely to spill their cargo do not require double bottom hulls on oil tankers. Senator Magnuson cites an Office of Technology Assessment that shows double bottoms to be of significant protection if grounding or collision occurs.

Oil transfer and transport

C-1197-76
THE RUSH FOR OFFSHORE OIL AND GAS: WHERE THINGS STAND ON THE OUTER CONTINENTAL SHELF

Anon. 1975.
Environmental Law Reporter 5(2):10026-10029.

The Ford Administration advocates developing offshore resources immediately, despite the lack of a comprehensive national policy and the failure of the Energy Supply Act of 1974. OCS leasing conflicts with the CEQ's recommendation that development be allowed only if environmental risks are outweighed by the benefits. Onshore environmental impact and state involvement are discussed.

General effects of oil prospecting and production

C-1198-76
TANKERS AND THE MARINE ENVIRONMENT, PART 1

Anon. 1975.
U.S. Congress, 94th, 1st Session. Senate. Committee on Commerce, National Ocean Policy Study. Hearings. 146 p.

These Hearings pertain to Coast Guard supervision of oil tankers entering U.S. waters under the Ports and Waterways Safety Act of 1972. The Senate Committee is concerned with insuring that tankers comply with U.S. safety liability regulations and with developing new ways of minimizing the possibilities of oil spillage.

Oil transfer and transport

C-1199-76
WHO PAYS FOR OIL SPILLS? YOU DO

Anon. 1976.
Environmental Action 7(18):13.

Although recent federal laws require those who spill oil to clean it up or pay government cleanup costs, individuals suffering pollution damage must take the spiller to court to obtain compensation. The need for comprehensive federal liability legislation to cover damages and pollution costs is emphasized. Two such proposals currently awaiting action are described.

Economic effects of oil pollution

C-1200-76

WHAT'S HAPPENING WITH MARINE ENVIRONMENTAL REGULATIONS

Brown, R. L., and T. H. Robinson. 1975.
Marine Technology 12(3):275-280.

The U.S. Coast Guard has the task of setting adequate standards for various types of vessels to prevent or minimize discharge of pollutants into the water. Standards dealing with tankship and tank barge design, tank slops, oily bilge wastes, spill containment, and vessel sewage are reviewed. Proposed requirements for vessel operation and vapor recovery are discussed.

Oil transfer and transport, Waste treatment and disposal methods, Containment

C-1201-76

INFLUENCE OF THE ENERGY CRISIS UPON THE FUTURE OF ENVIRONMENTAL POLICY

Dreyfus, D. A., and R. D. Grundy. 1974.
Environmental Affairs 3:252-274.

New national policies governing energy consumption, particularly those including environmental constraints, will be amended or revoked because they have not yet been incorporated into the structure of the energy systems and culture and economics of our society. Restructuring of policies will probably take place in areas of surface mining, the Alaska pipeline and emergency energy areas. However, it is unlikely that any major body of environmental law will be eliminated from the statutes.

C-1202-76

CIVIL PENALTIES FOR VIOLATION OF OIL POLLUTION PREVENTION REGULATIONS: INTERIM REGULATIONS

Environmental Protection Agency. 1974.
Federal Register 39(169):31601-31603.

The article outlines the EPA's Oil Pollution Prevention Regulations which are applicable to owners and operators of facilities that have a potential for discharging harmful quantities of oil. The regulations establish EPA procedures for issuance of violation notices, requests for and conduct of hearings, assessment of penalties, and penalty appeals.

Economic effects of oil pollution

C-1203-76
EPA BECOMES NEW FACTOR IN MARINE POLLUTION CONTROL

Green, F. 1976.
Sea Technology 17(1):14, 16.

The EPA cooperates with the Coast Guard in the mechanics of ocean cleanup and in international negotiations on ocean protection (such as the 1972 Ocean Dumping Convention). EPA is responsible for assuring the containment of polluting materials in non-transportation activities (storage tanks and refineries). Oil spill incidence and effects are briefly reviewed.

Reporting, Biological effects of oil pollution, International legislation

C-1204-76
NATIONAL OCEAN POLICY: PRIORITIES FOR THE FUTURE

Hollings, E. F. 1975.
Oceanus 19(1):9-19.

A national ocean policy to guide the use of offshore resources is needed. The following issues concerning OCS gas and oil development are elaborated: sufficiency of resource information for government planning, separation of exploration and development of OCS oil and gas, federal-state roles in OCS leasing decisions, equitable returns to government and industry for OCS development, and compensation to coastal states for adverse impacts of development.

General effects of oil prospecting and production, Economic effects of oil prospecting and production

C-1205-76
OFFSHORE OIL DRILLING AND ONSHORE IMPACT: THE LEGAL-INSTITUTIONAL REGULATORY FRAMEWORK

Mallon, L. G. 1974.
University of Miami, Sea Grant Institution Program Report, FY75-5.
15 p.

The Federal-state regulations affecting offshore production and associated onshore impacts are analyzed. The responsibilities of the various agencies for environmental assessment are reviewed. The topics of coastal zone management, oil pollution, environmental impact statements and leasing, as they are related to offshore drilling, are discussed.

General effects of oil prospecting and production, State legislation

C-1206-76
THE DEEPWATER PORTS ACT OF 1974; HALF SPEED AHEAD

Meltz, R. 1975.
Environmental Law Reporter 5(3):50043-50048.

The background, purposes, provisions, strengths and weaknesses of the Act are reviewed. The environmental impacts of superports and supertankers are considered in relation to the provisions of the Deepwater Ports Act. Topics discussed include oil spillage, cleanup side-effects, land-based development, oceanographic effects and human health and welfare. The author finds the Act a "reasonable legislative response" to a problem.

General effects of oil prospecting and production

C-1207-76
SELECTED U.S. LAWS APPLYING TO OFFSHORE STRUCTURES AND USES

Nyhart, J. D. 1975.
Oceanus 19(1):20-21.

Listed is a selection of U.S. federal laws pertaining to offshore structures and uses other than fishing. Water pollution regulations (including oil) are included.

C-1208-76
GUIDELINES FOR OIL AND GAS EXPLORATION AND DEVELOPMENT ACTIVITIES IN TERRITORIAL AND INLAND NAVIGABLE WATERS AND WETLANDS: PROPOSED ADOPTION

U.S. Fish and Wildlife Service. 1975.
Federal Register 40(137):30019-30024.

The guidelines of the U.S. Fish and Wildlife Service focus on the conservation and development of fish and wildlife, their habitats, and related human uses of water and wetlands. The federal permit system for developments such as drilling, pipeline construction, and offshore facilities in these areas is discussed.

General effects of oil prospecting and production

C-1209-76
REGULATORY FUNCTIONS AS RELATED TO VESSEL CONSTRUCTION AND OPERATION

Wallace, S. A. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop,

National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.). NBS Special Publication No. 409. p. 61-65.

The legal mandates of the Coast Guard and their monitoring applications are discussed. The Coast Guard is responsible for transportation-related facilities. They manage a pollution fund and maintain a National Strike Force for spill cleanup. Monitoring would be useful in detecting spills, assessing clean-up effectiveness and to serve as evidence in enforcement proceedings.

Monitoring, Cleanup and recovery

C-1210-76
FEDERAL ENVIRONMENTAL LAWS AND REGULATIONS

Zarytklewicz, E. D. 1975.
Chemical Engineering 82(21):9, 11, 13, 15, 17.

Recently enacted legislation, existing environmental regulations and future requirements that will affect the chemical process industries are described. Planning and enforcement of the National Oil and Hazardous Substances Pollution Contingency Plan by the EPA and U.S. Coast Guard are discussed in detail.

Contingency planning

3. INTERNATIONAL LEGISLATION

C-1211-76
CONVENTIONS RATIFIED TO PREVENT OIL POLLUTION OF COASTS

Anon. 1975.
Financial Times 23 June 1975.

The article covers the provisions of the International Convention on Civil Liability for Oil Pollution Damage, which has just come into force, and the International Convention relating to Intervention on the High Seas in cases of Oil Pollution Casualties.

General effects of oil pollution

C-1212-76
OCEAN DUMPING REGULATIONS NOW IN EFFECT (news brief)

Anon. 1976.
Western Fisheries 91(1):14.

As of December 13, 1975, all Canadian ocean dumping will be controlled by a federal permit system. The regulations on dumping are a result of the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972. Permits will not be granted for such substances as mercury, oils and high level radioactive materials.

Foreign legislation

C-1213-76
SEA LAW CONFERENCE FIZZLES OUT WITHOUT MUCH ACCOMPLISHED

Anon. 1975.
Offshore 35(8):43.

Despite the lack of concrete achievements, the conference pointed out the problems and possible solutions. Tanker regulations to stop spills and slop dumping are urgently needed. A United Kingdom delegate linked 203 out of 900 spills with particular vessels, but only 18 successful prosecutions were made. The economic zone concept, concerning control of the seabed, was another issue.

Oil transfer and transport

C-1214-76
CONVENTION FOR THE PREVENTION OF MARINE POLLUTION FROM LAND-BASED SOURCES

E.E.C. 1974.
Commission of the European Communities, COM(74)502 final/2. 53 p.

The geographical area covered by the Parish Convention is defined. Contracting parties will control discharge of listed pollutants, carry out research, monitoring and advisory programmes, formulate regulations and exchange information.

C-1215-76
LIABILITY FOR OIL POLLUTION DISASTERS: INTERNATIONAL LAW AND THE DELIMITATION OF COMPETENCES IN A FEDERAL POLICY

Goldie, L. F. E. 1975.
Journal of Maritime Law and Commerce 6(3):303-329.

IMCO's Liability and Fund Conventions, if ratified, will establish absolute liability for damages caused by extrahazardous activities and an international fund for compensation. The creation of a uniform liability law, basis for damages, and process for recovery would eliminate the inconsistencies in present state laws.

U.S. legislation, Economic effects of oil pollution

C-1216-76
WHO PROTECTS THE OCEAN? ENVIRONMENT AND THE DEVELOPMENT OF THE LAW OF THE SEA

Hargrove, J. L. (ed.) 1975.
St. Paul, Minn., West Publishing Co., 1975. xiv, 250 p.

Summary not available.

C-67-76
MARITIME CONSIDERATIONS

Nachtscheim, J. J. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop, National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.). NBS Special Publication No. 409. p. 49-56.

Two provisions of the 1973 International Convention for Prevention of Pollution from Ships will be difficult to achieve. Oil content meters, oily water separators and segregated ballast are discussed in conjunction with the Maritime Administration's efforts to overcome difficulties in these 2 areas.

Oil transfer and transport

C-1217-76
LEGAL MEASURES CONCERNING MARINE POLLUTION

North Carolina State University, Raleigh. 1975.
Sea Grant Publication UNC-SG-75-04. 83 p.

This compilation of papers contains new concepts and developments in marine pollution control. Among the topics covered are: man-made islands and resulting environmental implications, legislation to prevent pollution, the use of the oceans as international disposal sites for industrial chemical waste materials, a new approach to pollution control on an international level, and controversies in pollution control as a result of the trans-Alaskan pipeline.

General effects of oil pollution, Waste treatment and disposal methods

C-1218-76
TREATIES AIM TO CURB MEDITERRANEAN POLLUTION

O'Sullivan, D. A. 1976.
Chemical & Engineering News 54(8):19.

A conference held in Barcelona in February, 1976, produced a framework convention. One protocol concerns dumping from ships and aircraft; another, pollution by oil and other toxic substances. Protocols still in the formulation stage, details of substances included in the protocols, and the formation of a pollution monitoring system are discussed.

Waste treatment and disposal methods, Monitoring

C-1219-76
INTERNATIONAL REGULATION OF PETROLEUM EXPLORATION AND EXPLOITATION ON THE HIGH SEAS

Routh, J. S. 1974.
Emerging Ocean Oil and Mining Law. S. W. Wurfel (ed.). North Carolina, Sea Grant Publication, NCU-SG-74-02. p. 1-11.

The technology of deepwater exploration and production of hydrocarbons is reviewed. International law relevant to petroleum resources under the high seas and its evolution are described. Proposed changes in that law because of the 1974 UN Conference on the Law of the Sea are discussed. One source of conflict is the lack of a law prohibiting the exploitation of resources under the high seas.

General effects of oil prospecting and production

4. FOREIGN LEGISLATION

C-1220-76
MERCHANT SHIPPING (OIL POLLUTION) ACT 1971

Anon. 1975.
H.M.S.O. 22 p.

The Act defines liability for damage caused by escape or discharge of oil from ships. Regulations concerning compulsory insurance are included.

Economic effects of oil pollution

C-1221-76
THE GOVERNMENT VIEWPOINT ON POLLUTION FROM OFFSHORE OIL ACTIVITIES AND EMERGENCY PLANS

Molyneux, J. A. 1975.
Petroleum and the Continental Shelf of North West Europe.
H. A. Cole (ed.). United Kingdom, Applied Science Publishers, 1975. Vol. 2. Environmental Protection. p. 57-61.

Government measures to reduce the risk of oil pollution from offshore operations and to deal with emergencies are reviewed. The Prevention of Oil Pollution Act 1971, the Petroleum (Production) Regulations, 1964, 1966 and 1971, and the Mineral Workings (Offshore Installations) Act 1971 are discussed. Reference is made to the pollution implications of accidents to installations and pipelines.

Contingency planning. General effects of oil pollution

C-1222-76
THE LAW RELATING TO THE POLLUTION OF THE SEAS

Mensah. T. A. 1974.
Environmental Pollution Control: Technical. Economic and Legal Aspects. A. D. McKnight. and P. K. Marstrand (eds.). London. Allen and Unwin, 1974. p. 174-208.

International regulations and legislation governing the following types of pollution are reviewed for the United Kingdom and other countries (i.e., Canada, U.S., Norway): land-based pollutants, dumping of wastes into the sea, shipborne pollutants (oil), shipborne pollutants other than oil, pollution arising from the exploration and exploitation of seabed and subsoil, and radioactive pollutants.

International legislation, U.S. legislation

C-1223-76
ECOLOGY, ENERGY AND ECONOMICS

Pitts, J. N., et al. 1975.
Chemistry in Britain 11(7):247-256.

A number of examples of environmental pollution due to energy utilization is given. In these cases insufficient research preceded the introduction of legislation, so that policy makers were unprepared to make optimum decisions balancing the environment, energy and economics.

General effects of oil pollution

C-1224-76
THE QUEST FOR OIL: A DECISIVE FORCE IN THE LAW OF THE ARCTIC SEA PERTAINING TO POLLUTION

Wyatt, J. C. 1975.
Legal Measures Concerning Marine Pollution. Sea Grant Publication, UNC-SG-75-04. p. 72-80.

As a result of the construction of the Trans-Alaska Pipeline, attention has been focused on the arctic waters. The Canadian Arctic Waters Pollution Prevention Act was an attempt by the Canadian government to meet the threat of arctic water pollution. Existing international law does not provide specific principles governing ocean pollution. Present controversies over this topic demonstrate a need for such policies.

General effects of oil pollution

5. INDUSTRY, STANDARDS AND GUIDELINES

C-1225-76
RELATIONSHIP BETWEEN THE OFFSHORE PETROLEUM INDUSTRIES AND THE U.S. GOVERNMENT

Anon. [undated]
National Security Industrial Association Report. 43 p.

Petroleum Panel recommendations for federal governmental activity in the petroleum industry include: determination of the fate and effects of oil in the marine environment, assistance to states in coastal planning and management for offshore development, improvement of weather information and marine conditions in development areas, and improvement of bathymetry and surface geologic mapping of certain seabed areas.

General fate of oil in the environment, General effects of oil pollution

C-1226-76
GOVERNMENTS, THE OIL INDUSTRY AND THE ENVIRONMENT

Blaikley, D. R. 1975.
Petroleum Review 29(340):233-243.

Cooperation inside the oil industry and between industry and governments concerning environmental protection while developing resources is discussed. The objectives of the Oil Industry International Exploration and Production Forum are reviwed; communication and cooperation are vital.

General effects of oil prospecting and production

C-1227-76
EUROPEAN MODEL CODE OF SAFE PRACTICE FOR THE PREVENTION OF GROUND AND SURFACE WATER POLLUTION BY OIL FROM STORAGE TANKS AND DURING THE TRANSPORT OF OIL

European Petroleum Organisations. 1974.
Barking, Essex, Applied Science Publishers Ltd., 1974. 23 p.

The code covers pollution prevention, corrosion protection, location of storage tanks and associated equipment. Other sections cover operation, transportation and emergencies.

Oil transfer and transport

G. BIBLIOGRAPHIES

C-1228-76
LITERATURE REVIEW ISSUE

Anon. 1974.
Journal Water Pollution Control Federation 46(6):1031-1643.

Literature reviews are presented on monitoring, analysis and sampling; physical and chemical methods; water reclamation and reuse, industrial wastes including those from the meat-processing, metals, petrochemical and chemicals industries; microbiology of waste treatments; marine and estuarine pollution; pollution effects on fish and others.

Waste treatment and disposal methods, General effects of oil pollution

C-1229-76
THE IMPACT OF ENERGY DEVELOPMENTS ON WATER RESOURCES IN ARID LANDS. LITERATURE REVIEW AND ANNOTATED BIBLIOGRAPHY

Bowden, C. 1975.
Arizona University Report, No. Arid Lands Resource-IP-6 W75-05471, OWRT-W-180 (4258) (1). 288 p.

The consequences of energy extraction and conversion in arid lands where water is scarce are examined. Energy sources including oil, oil shale and gas, are reviewed in terms of the effects of their development on the air, land, water and inhabitants of arid regions.

General effects of oil prospecting and production

C-1230-76
BIBLIOGRAPHY ON GROUNDWATER POLLUTION

Cole, J. A., E. S. Hall, A. H. Blair, and J. L. Robinson. 1974.
Ground Water Pollution in Europe. J. A. Cole (ed.). Conference of the Water Research Association, Reading, England, 1972.
p. 465-516.

This bibliography covers the period 1950 to 1973. The references are placed in one of 8 sections: bibliographies and symposia, administrative and general, groundwater flow and pollution dispersion, artificial recharge, underground waste disposal, surface waste disposal, specific pollutants, and purification processes.

C-1231-76
WATER ANALYSIS

Fishman, M. J., and D. E. Erdmann. 1975.
Analytical Chemistry 47(5):334R-361R.

This review of the literature of analytical chemistry as applied to water analysis covers the period from October, 1972, to September, 1974, and includes a subsection on organics. Papers referring to oil pollution source identification, and analysis of hydrocarbons in seawater and soil samples are reviewed.

Analysis, Source identification

C-1232-76
OIL SHALE (A BIBLIOGRAPHY WITH ABSTRACTS)

Hundeman, A. S. 1975.
NTIS/PS-75/362/4GA. 142 p.

"Exploration, mining, retorting, chemistry, environmental impacts, and policies relating to oil shale research are covered."

General effects of oil prospecting and production

C-1233-76
THE TOXICITY OF DRILLING FLUID COMPONENTS TO AQUATIC BIOLOGICAL SYSTEMS, A LITERATURE REVIEW

Land, B. 1974.
Canada, Fisheries and Marine Service (Winnipeg). Technical report no. 487. 33 p.

This review covers the literature prior to January, 1974, on drilling fluid toxicity to aquatic organisms. After consideration of the quantities used, and the harmful long-term effects, the alkaline sources, bactericides, barium sulphate, bentonite, chromium salts and potassium chloride are designated as the major sources of aquatic toxicity.

Biological effects of oil prospecting and production

C-1234-76
A BIBLIOGRAPHY ON MARINE AND ESTUARINE OIL POLLUTION. SUPPLEMENT 1.

Moulder, D. S., and A. Varley. 1975.
Plymouth, United Kingdom, Marine Biological Association of the United Kingdom, 1975. 157 p.

This supplement to the 1971 bibliography contains 1200 additional references. The citations are arranged by subject. The topics include detection and analysis of oil, reports on particular spills, biological effects of oil and methods of control of oil pollution.

Analysis, Reporting, Biological effects of oil pollution, Cleanup and recovery

C-1235-76
ENERGY/ENVIRONMENT ABSTRACTS

Pavoni, J. L., D. J. Hagerty, and J. E. Heer, Jr. 1975.
Louisville, Kentucky, Pollution Abstracts, Inc., 1975. 977 p.

5,136 summaries of the technical literature published in 1969-1973 that deals with the impact of energy sources on the environment are included. Subjects covered include energy sources and recovery, effects of energy use, monitoring pollutants from energy sources, reducing energy-related pollutants and legal and administrative aspects.

General effects of oil prospecting and production, Monitoring

C-1236-76
POLLUTION EFFECTS ON SURFACE WATERS AND GROUND WATERS (LITERATURE REVIEW)

Young, R. H. F. 1975.
Journal Water Pollution Control Federation 47(6):1600-1610.

The causes of groundwater pollution include land and subsurface disposal of waste water, radionuclides, biological contamination, phenol, DDT, soil and grease, etc. The effects of outboard motor subsurface exhausts were reported. In the years reviewed (1973-1974) urban runoff and nonpoint sources became more frequent research topics.

Chemical effects of oil pollution

SECTION II. CURRENT RESEARCH PROJECTS

Title, contract, information and a summary of project objectives are provided in each entry. Project notices were obtained from the Smithsonian Science Information Exchange (SSIE), Maritime Information Research Service, Aquatic Microbiology Newsletter, granting agencies and individual researchers. Current status information and publications resulting from the projects are presented when such information was available from the principal investigator or performing organization. The source of status information is given at the end of each entry.

Entries are grouped according to subject and then ordered by serial number within each subject division. The serial number designates the original issue of OIL SPILL AND OIL POLLUTION REPORTS in which the research project is listed:

R-001-74 to R-165-74	EPA-670/2-75-003 July 74 to October 74
R-166-74 to R-244-74	EPA-670/2-75-004 November 74 to February 75
R-269-74 to R-342-74	May 75 to July 75
R-269-75 to R-304-75	August 75 to October 75
R-1-76 to R-35-76	November 75 to January 75
R-35-76 to R-63-76	February 76 to April 76

A. OIL POLLUTION DETECTION AND EVALUATION

1. MONITORING

R-008-74 (renewal)
SHIPBOARD WASTEWATER OIL DETECTOR

Principal Investigator: Unknown
Performing Organization: Reentry and Environment Systems Division, General Electric Company, 3198 Chestnut St., Philadelphia, Pennsylvania 19101
Supporting Agency: U.S. Department of Transportation, Coast Guard, Contract 038987
Period: 7/75 to 6/76

Waste treatment and disposal method, Design and engineering

Several phases are included in this project: laboratory development program, optical discrimination development testing, centrifugal separation development testing, laboratory test program, and conceptual design.

Results

OPL OIL/WATER SEPARATORS FOR LAND APPLICATIONS

General Electric Product Information

In this device, influent first passes over a weir, depositing most solids upstream of the weir, and much oil is gravity separated here before the water enters the plates for polishing. As oil is removed from the water, it rises to the surface where it is trapped by an oil dam and removed by gravity flow through the standpipe skimmer. Clean water flows under the dam and out.

SHIPBOARD OIL/WATER SEPARATORS FOR BILGE, TANK WASHINGS AND DEBALLASTING

General Electric Product Information

Water flows horizontally through the GE separators. Oil droplets as small as 20 microns impinge and coalesce on the oleophilic plates and rise through weep holes in the plates to the surface, where the oil is removed automatically. The cleaned water is suitable for dumping.

Information Source: M. J. Sullivan, Product Information, Reentry and Environment Systems Division, General Electric Company, 3198 Chestnut St., Philadelphia, Pa. 19101

R-36-76
DEVELOPMENT OF OCEAN SYSTEMS OIL LEVEL SENSING

Principal Investigator: Posakony, G. T.
Performing Organization: Battelle Memorial Institute, 505 King Ave., Columbus, Ohio 43201
Supporting Agency: U.S. Department of Transportation, Coast Guard, Contract 058001
Period: 7/74 to 6/75 Funds: $3,401

Design and engineering, Cleanup and recovery

The thickness measurement portion of the oil recovery system will be evaluated by determining the accuracy of the testing and discussing operational problems with the Coast Guard. The effectiveness of Battelle Northwest in advising the Coast Guard on design changes or sensor improvement will be included.

R-37-76
BIRDS/MAMMALS OF THE SOUTHERN CALIFORNIA OCS
CHEMICAL/BIOLOGICAL BENCHMARK STUDIES OF THE SOUTHERN CALIFORNIA OCS
GEOLOGIC BENCHMARK STUDY OF THE SOUTHERN CALIFORNIA OCS

Principal Investigator: Unknown
Performing Organization: University of California, Santa Cruz; Science Applications Inc.; U.S. Geological Survey
Supporting Agency: U.S. Department of the Interior
Period: 3/75 to 8/76, 6/75 to 8/76, 4/75 to 6/76

Monitoring

Baseline studies of the Southern California Bight area will be initiated to delimit natural communities and to establish ambient levels of hydrocarbons and selected trace metals in water, sediments, organisms and on particulates. A baseline survey of the birds and mammals of the Southern California Bight and intertidal surveys of selected areas of the southern California coastline will be conducted. In addition, the U.S. Geological Survey will perform high resolution seismic mapping of bottom topography, particularly of potential geologic hazards.

R-38-76
DATA BUOY EMPLACEMENT IN MID-ATLANTIC AND NORTH ATLANTIC OCS

Principal Investigator: Unknown
Performing Organization: National Oceanic and Atmospheric Administration, National Data Buoy Office
Supporting Agency: U.S. Department of the Interior
Period: 7/75 to indefinite

This project is a part of the Department of Interior's OCS environmental program related to oil and gas exploration and development.

R-39-76
GENERAL BENCHMARK STUDIES FOR ALASKA

Principal Investigator: Unknown
Performing Organization: National Oceanic and Atmospheric Administration, Environmental Research Laboratory
Supporting Agency: U.S. Department of the Interior, Bureau of Land Management
Period: 8/75 to 10/76

The baseline environmental studies for the Gulf of Alaska, Southeastern Bering and Beaufort Seas are multidisciplinary investigations of the marine, littoral and onshore biota, chemistry (with particular emphasis on hydrocarbons and heavy metals), physical oceanography, geology, meteorology and ice.

R-40-76

MONITORING STUDY FOR NORTHEASTERN GULF OF MEXICO

Principal Investigator: Unknown
Performing Organization: State University System Institutions of Oceanography (SUSIO), Florida
Supporting Agency: U.S. Department of the Interior
Period: 6/75 to 12/76

"Summary of Hydrographic data, eastern Gulf of Mexico." The project is part of the Department of Interior's OCS environmental program related to oil and gas exploration and development.

R-41-76

PHYSICAL OCEANOGRAPHY AND METEOROLOGY OF THE MID-ATLANTIC REGION
CHEMICAL/BIOLOGICAL BENCHMARK STUDY OF THE MID-ATLANTIC REGION
GEOLOGIC BENCHMARK STUDY OF THE MID-ATLANTIC REGION

Principal Investigator: Unknown
Performing Organizations: National Oceanic and Atmospheric Administration, Environmental Data Service; Virginia Institute of Marine Science; U.S. Geological Survey
Supporting Agency: U.S. Department of the Interior
Period: 1/76 to 4/77, 6/75 to 8/76

Monitoring, General fate of oil in the environment

The program of study for the Mid-Atlantic Region is to be carried out in three separate parts. The Virginia Institute of Marine Sciences will be responsible for delineating natural communities and for establishing ambient levels of hydrocarbons and selected trace metals in the water column, organisms and on particulates. The USGS will undertake a baseline survey of the geological and geophysical properties of the Mid-Atlantic area. This effort will include mapping of geologic hazards, sampling sedimentary environments, mass transport study and establishing ambient levels of hydrocarbons and trace metals in the sediments. NOAA will provide information relating to the physical oceanography of the region, development of a water circulation model and an oil spill trajectory model, and expansion of the MARMAP program.

2. ANALYSIS

R-42-76

EVALUATION OF THE QUALITY OF URBAN STORMWATER RUNOFF

Principal Investigators: Bennett, E R., and K. D. Linstedt
Department: Civil and Environmental Engineering
Performing Organization: University of Colorado, School of Engineering, 1200 University Ave., Boulder, Colorado 80302
Supporting Agency: U.S. Department of the Interior, Office of Water Research and Technology, No. A-028-COLO
Period: 7/75 to 6/76 Funds: $10,000

The characteristics and effects of stormwater drainage will be investigated. Stream areas with different types of development will be analyzed for flow, total and volatile solids, suspended matter, oily compounds, BOD, COD, nitrogen compounds, hardness, phosphorus, pH and temperature, sodium and chloride and heavy metals. Potential methods of pollution control for these discharges will be evaluated.

R-43-76

MULTIVARIATE ANALYSIS OF MAFLA WATER COLUMN DATA

Principal Investigator: Unknown
Performing Organization: University of Florida
Supporting Agency: U.S. Department of the Interior
Period: 3/75 to 1/76

This project is a part of the Department of Interior's OCS environmental program related to oil and gas exploration and development.

3. SOURCE IDENTIFICATION

R-5-76
QUALITY OF CRUDE OILS AND PRODUCTS - OIL SPILL IDENTIFICATION

Principal Investigator: Coleman, H. J.
Performing Organization: Bartlesville Energy Research Center,
Bartlesville, Oklahoma 74003
Supporting Agency: U.S. Energy Research and Development Administration
Period: 2/72 to 6/80 (approx.)

Analysis

The project is active and is pursuing the objective of determining and measuring optimum, distinctive properties of crude oils and crude oil residues and establishing interrelationships of these diverse properties for improved oil spill "fingerprinting" and identification. Crude oils from around the world are analyzed and resultant data are placed in an open file for ready access and use.

Reports and Publications

IDENTIFICATION OF WATER-BORNE OILS

Ward, C. C. (in press)
The Petroleum Petrochemical Industry--An Analysis of Some Key Factors, Puerto Rico, 1973. Special Seminar.

A catalog listing unique properties of crude oils is being developed by the Bureau of Mines to identify the country of origin of unknown crude spills. Techniques are described for the collection, preparation and analysis of oil samples, comparison with suspected sources and identification of the source, even after weathering and bacterial degradation.

CRUDE OIL SPILLS RESEARCH. AN INVESTIGATION AND EVALUATION OF ANALYTICAL TECHNIQUES

Wilson, C. A., and E. P. Ferrero. 1975.
U.S. Bureau of Mines Report of Investigations, No. 8024. 28 p.

The program to investigate and evaluate analytical techniques for the simple, rapid and reliable identification of crude oil spills is described. Gas-liquid chromatographic analysis, atomic absorption spectrophotometric analysis and sulfur-nitrogen determinations are recommended as the most useful techniques investigated.

Information Source: H. J. Coleman, Chemistry and Refining Research,
Bartlesville Energy Research Center, P.O. Box
1398, Bartlesville, Oklahoma 74003

R-44-76

HYDROCARBON POLLUTION OF AIR AND WATER

Principal Investigator: Draper, R. G.
Performing Organization: Canada. Department of Energy and Resources,
Centre for Mineral Energy and Technology,
555 Booth St., Ottawa, Ontario K1A 06I,
Canada
Supporting Agency: Canada. Department of Energy and Resources,
Centre for Mineral Energy and Technology
Period: 4/75 to 3/76

Analysis, Chemical changes of oil in the environment, Physical changes of oil in the environment

The objectives of this research are to collect information on characteristic types of petroleum products and to determine the effects of oxidation, migration and solubility in water on these types. Contaminated samples will be analyzed and the data interpreted.

Status: The work relating to oil spills has been completed.

Reports and Publications

A GAS LIQUID-GAS SOLID CHROMATOGRAPHIC METHOD FOR THE IDENTIFICATION OF SOURCES OF OIL POLLUTION

George, A. E., G. T. Smiley, D. S. Montgomery, and H. Sawatzky. 1973.
Department of Energy, Mines and Resources, Mines Branch, Ottawa, Research report R-267. 22 p.

A two-step gas chromatographic fingerprinting technique has been developed for the identification of petroleum from oil spills. It consists of a gas chromatographic separation on non-polar silicone rubber followed by further separation by gas chromatography on columns of lithium chloride supported on diatomaceous silica. The method has been applied to heavy crudes and fuel oils involved in spills from the "Arrow" and "Irving Whale."

Information Source: H. Sawatzky, Canada Centre for Mineral and
Energy Technology, 555 Booth St., Ottawa,
Canada K1A 061

B. OIL POLLUTION PREVENTION AND CONTROL

1. CLEANUP AND RECOVERY

R-154-74 (renewal)
PROTOTYPE OIL RECOVERY SYSTEM FOR USE ON THE HIGH SEAS, PHASE II/
LOCKHEED

Principal Investigator: Unknown
Performing Organization: Lockheed Missiles and Space Co.,
1111 Lockheed Way, Sunnyvale,
California 94088
Supporting Agency: U.S. Department of Transportation, Coast
Guard, Contract 025418
Period: 7/74 to 6/75 Funds: $91,487

Design and engineering

A comprehensive loads analysis and a loads analysis for the internal pressure of the inflation system will be combined to form the basis of the structural criteria to be used in designing the pontoons. More loads analyses of localized areas may be required as the design progresses.

Status: The final report for this project has been submitted to the U.S. Coast Guard, Report CG-D-150-75 "Prototype High-seas Disc-drum Oil Recovery System." It is available through the National Technical Information Service.

Reports and Publications

PROTOTYPE HIGH-SEAS DISC-DRUM OIL RECOVERY SYSTEM.

Unknown. 1975.
Report CG-D-150-75.

This report documents the design, construction and testing of the high-seas disc-drum oil recovery system for the U.S. Coast Guard by Lockheed Missiles & Space Co., Inc. The unit is designed to recover up to 1,000 gpm of a wide variety of oils in up to Sea State 4 conditions, to survive Sea State 6, and to return to operating at a spill scene without major repair.

Information Source: R. R. Beall, Lockheed Missiles & Space Company,
Inc., 1111 Lockheed Way, Sunnyvale, Calif. 94088

R-155-74 (renewal)
PROTOTYPE OIL RECOVERY SYSTEM FOR USE ON THE HIGH SEAS, PHASE II/
OCEAN SYSTEMS INC.

Principal Investigator: Unknown
Performing Organization: Ocean Systems Incorporated, 11440 Isaac Newton Ind. Sq. N., Herndon, Virginia 22070
Supporting Agency: U.S. Department of Transportation, Coast Guard, Contract 025419
Period: 7/75 to 6/76

Design and engineering

The effects of raising the weir lip and placing various screens over the weir opening will be investigated, theoretically and experimentally.

R-299-74 (renewal)
FAST CURRENT OIL RESPONSE SYSTEM

Principal Investigator: Beach, R. L.
Performing Organization: Seaward Incorporated, 6269 Leesburg Pike, Falls Church, Virginia 22044
Supporting Agency: U.S. Department of Transportation, Coast Guard, Contract 055588
Period: 7/75 to 6/76

Design and engineering

A system capable of performing effectively in a variety of oil spill conditions and in current velocities of 4-10 knots will be developed in order to minimize the technical risks associated with the control of oil slicks in fast currents.

Status: Additional work is underway, and future reports will be forthcoming.

Results

HUSKEY OFFSHORE SKIMMER

Seaward International Product Information

The Huskey Offshore Skimmer is designed to skim oil in moderate sea conditions. It has proven itself off Santa Barbara, in the Gulf of Mexico and offshore Indonesia. The gathered oil and water flow into the skimmer and are separated due to the decreased velocity. The oil spills over the weir into a sump, and the clean water is discharged.

LOOKING SEAWARD (newsletter)

Seaward International. February, 1976.

This newsletter contains information on Seaward's oil pollution control products. A stainless steel version of the SLURP oil skimmer was designed to clean up oil spilled in confined bodies of water. Spiltral Harbor Skimmers feature high speed and high collection efficiency; they are self-propelled.

Information Source: Seaward International, Suite 204,
6269 Leesburg Pike, Falls Church,
Virginia 22044

R-10-76

LITERATURE ON PENETRATING SEA-ICE, AND RECOVERY, TRANSFERRAL, SEPARATION AND DISPOSAL OF OIL SPILLED UNDER ARCTIC ICE (ABBREV)

Principal Investigator: Unknown
Performing Organization: Montreal Engineering Company Ltd., Montreal, Quebec, Canada
Supporting Agency: Canada, Department of the Environment, No. SS01 KE204-4-EP10/12/13
Period: 11/74 to 10/75 Funds: $116,112

No summary provided to SSIE.

Status: Two projects for the Centre of Spill Technology, Canada Centre for Inland Waters, Burlington, Ontario, have been completed. The results of these programs are presently being published and should be available through Research and Development Division, Environmental Emergency Branch, Environment Canada, Ottawa, Ontario, K1A OH3 Canada.

Reports and Publications

A REVIEW OF OIL SPILL COUNTERMEASURES

Anon. (in press)
Beaufort Sea Project, Technical Report 31.

The report discusses the feasibility of controlling and cleaning up an oil spill in the Beaufort Sea as a result of an exploratory well blowout. Results indicate that in open water (up to 10% ice intrusions), currently available oil spill countermeasures equipment and techniques could be employed in light sea conditions up to Beaufort 3. No equipment is available for use in heavier sea conditions. In general, the logistical base to support an effective oil spill countermeasures operation is not available in areas adjoining the Beaufort Sea.

FIELD EVALUATION OF MECHANICAL OIL RECOVERY EQUIPMENT

Anon. (in press)

Seven oil spill recovery devices were evaluated in a series of test programs. It was found that the "DIP 2001," manufactured by JBF Scientific Co. Ltd., and the "Oil Mop Mark II-9D," manufactured by Oil Mop Pollution Control Ltd., exhibit an ability to recover spilled crude oil at efficiencies in excess of 70% when operating under a specified range of limiting and environmental factors. Overall, the skimmers were generally more effective in dealing with greater thicknesses of oil, had a tendency to emulsify fresh oil during the collection process, and had as the weakest link in the recovery system the pumping mechanisms.

Information Source: W. J. Logan, Centre of Spill Technology,
Environmental Protection Service, Environmental Emergency Branch, 867 Lakeshore Rd.,
P.O. Box 5050, Burlington, Ontario. L7R 4A6

2. OIL TRANSFER AND TRANSPORT

R-45-76

CRUDE OIL LOSSES AND POLLUTION TANKER INERTING AND CLEANING, HUMAN SAFETY AND FLUOROSOLVENTS

Principal Investigator: Brauer, M.
Performing Organization: Texas A & M University, Industrial Engineering Department, College Station, Texas 77843
Supporting Agency: Texas A & M University, Industrial Engineering Department
Period: Unknown

Waste oil and waste water treatment

The primary part of the proposal is to study a process of recapturing the crude oil "tank bottoms" that create 6,448,571,400 gallons of pollution along the Texas Gulf Coast each year. The closed-loop in-port process will be evaluated in terms of developing a procedure keyed to "zero-discharge." Current litigation and cleanup requirements will also be reviewed.

Status: The Crude Oil Recovery Project (CORP) is currently attempting to apply its study system to the solution of North America's railroad tank car problems in Texarkana, Texas.

Reports and Publications

A SYSTEM FOR THE REDUCTION OF AIR AND WATER POLLUTION AND THE LOSS OF HUMANS, CRUDE OIL, AND SHIPS

Abstract only. No other information given.

On February 1, 1972, 39 crewmen were lost along with a U.S. tanker offshore in the Gulf of Mexico in 90 feet of water. A similar disaster occurred in January 22, 1975, when the 'Lucky Era' exploded, killing two crewmembers. This research investigates an industrially engineered concept as a cost-effective system to meet the need for a safe, universal, yet economical technique to effectively inert and clean tanks. The system uses a single, waterless inert/cleaning agent in a continuous-stream, closed loop activity in a modular, integrated, single-point-mooring configuration.

DEMONSTRATION OF ENERGY, FACILITIES AND HUMAN RESOURCE CONSERVATION AND POLLUTION ABATEMENT IN CRUDE-OIL TRANSPORTATION AND STORAGE

(TAMU-RF-75-367) FEA, 1975.

FUNCTIONAL REALLOCATION AND WORKPLACE REDESIGN FOR MUCKER OCCUPATIONAL SAFETY AND HEALTH

(TAMU-RF-75-406) NIOSH, 1975.

Information Source: M. Brauer, 18 Heatherwood, Texarkana,
Texas 75501

3. WASTE TREATMENT AND DISPOSAL METHODS

R-46-76
THE EFFECT ON WATER QUALITY AND AQUATIC ORGANISMS OF "BEST PRACTICABLE TECHNOLOGY" REFINERY EFFLUENT TREATMENT

Principal Investigators: Dorris, T. C., S. L. Burks, and J. L. Wilhm
Performing Organization: Oklahoma State University, Reservoir Research Center, Life Sciences West 427, Stillwater, Oklahoma 74074
Supporting Agency: U.S. Department of the Interior, Office of Water Research and Technology, No. B-033-OKLA
Period: 7/75 to 6/76

Biological effects of oil pollution

Fathead minnows will be used for a continuous flow toxicity bioassay of oil refinery effluents that have been through a secondary activated sludge treatment and dual media filters. The effects of this effluent on the diversity and growth of periphyton will also be investigated. The treatment process is being evaluated for potential use in control technology.

Status: The report is ongoing. No reports have been published at this time. The technical completion report of the previous study conducted in this area is summarized.

Reports and Publications

EFFECTS OF RESIDUAL TOXINS IN OIL REFINERY EFFLUENTS ON AQUATIC ORGANISMS

Dorris, T. C., S. L. Burks, and G. R. Waller. 1974. Oklahoma Water Resources Research Institute, Technical Completion Report, OWRR B-025-OKLA. 79 p.

Oil refinery waste waters were partially evaporated; the toxicities of the original sample and of the overhead and bottom fractions from the evaporator were evaluated by static bioassays with fathead minnows. It was concluded that partial evaporation removes toxic substances from biologically treated refinery waste waters, produces an overhead product water which has a low inorganic salt concentration and produces a partially concentrated bottom water product generally less toxic and suitable for discharge into a receiving stream.

Information Source: S. L. Burks, Reservoir Research Center, Oklahoma State University, Life Sciences West 427, Stillwater, Oklahoma 74074

4. PERSONNEL TRAINING AND EDUCATION

R-13-76
NATIONAL OIL SPILL TRAINING PROGRAM

Principal Investigator: Franklin, H. L.
Performing Organization: Texas A & I University, Corpus Christi,
P.O. Box 6010, Corpus Christi, Texas 78411
Supporting Agency: U.S. Energy Research and Development Administration
Period: 10/75 to 1977 (expected) $287,000

Cleanup and recovery, Oil transfer and transport

Texas A & I University has contracted with ERDA to prepare a curriculum for a possible national oil spill training school. The course to be developed would focus on cleanup of oil spills from terminals, barge and tanker accidents, pipeline ruptures and spills associated with exploration and production facilities that could affect the aquatic environment.

Status: Phase One of the curriculum is expected to be completed by late June or July, 1976. The "state of the art" of oil spill containment, harvest and disposal as it is being practiced on the East, West and Gulf coasts, is being documented. Phase Two will comprise the actual teaching process.

Information Source: H. L. Franklin, Project-STEP, Texas A & I
University, Corpus Christi, P.O. Box 970,
Corpus Christi, Texas 78403

R-47-76
SHIPBOARD GUIDE TO POLLUTION FREE OPERATIONS

Principal Investigator: Unknown
Performing Organization: U.S. Department of Commerce, Maritime
Administration, 26 Federal Plaza, New
York, New York 10007
Supporting Agency: Maritime Administration
Period: Unknown

Oil transfer and transport

The Maritime Administration is preparing an anti-pollution manual entitled "Shipboard Guide to Pollution Free Operations." It is a practical, informative reference source designed to promote pollution-free performance of duties by both licensed and unlicensed personnel aboard ships, especially tankers. The manual is organized into three general topic areas:

1) THE ENVIRONMENT
   - composition of the marine environment
   - existing threat to the marine environment
   - national/international pollution prevention activity

2) THE VESSEL
   - role of the vessel in fighting pollution
   - pollution free tanker operations
   - pollution controls and countermeasures

3) THE PEOPLE
   - role of a well trained crew
   - shipboard anti-pollution organization and training
   - incentives and awards

A final draft of the manual is underway and publication is scheduled for summer, 1976.

C. EFFECTS OF OIL POLLUTION

1. BIOLOGICAL EFFECTS

R-094-74

NAVY ENVIRONMENT: EFFECTS OF OIL POLLUTION ON MARINE MACROORGANISMS

Principal Investigator: Kittredge, J. S.
Performing Organization: City of Hope National Medical Center, Duarte, California
Supporting Agency: U.S. Department of Defense, Navy DN 123140 Contract N00014-71-C-0103
Period: 7/73 to 6/74 Funds: $18,363

Several crude oils will be fractionated and the resultant compounds measured for toxicity or the chemoreceptive membranes of marine macroorganisms.

Status: The project is no longer active.

Reports and Publications

BIOASSAYS INDICATIVE OF SOME SUBLETHAL EFFECTS OF OIL POLLUTION

Kittredge, J. S., and F. T. Takahashi. 1974.
Marine Technology Society Annual Conference, 10th, Washington, D.C., 1974.

Investigations were conducted to examine the effects of the water-soluble component of crude oils on chemically triggered behavioral responses of crabs. Exposure of crabs to the water-soluble extracts of two crude oils inhibited both the feeding response and the mating stance response of males when presented with a female sex pheromone.

SUBLETHAL EFFECTS OF THE WATER SOLUBLE COMPONENT OF OIL: CHEMICAL COMMUNICATION IN THE MARINE ENVIRONMENT

Takahashi, F. T., and J. S. Kittredge. 1973.
The Microbial Degradation of Oil Pollutants. D. G. Ahearn and S. P. Meyers (eds.). Baton Rouge, Louisiana, Center for Wetland Resources, 1973. p. 259-264. (Publication No. LSU-SG-73-01).

Crude oil and petroleum products contain water-soluble components that are potential inhibitors to chemoreception in marine organisms. Disruption of chemoreception in the marine environment by oil spills can have profound effects on survival and reproduction. These effects will be detected by the usual toxicity (LD) studies of pollutants.

Information Source: J. S. Kittredge, Comparative Marine Biochemistry and Pharmacology, Marine Biomedical Institute, University of Texas, 200 University Blvd., Galveston, Texas 77550

R-288-75
A STUDY OF THE CHEMICAL FATE AND THE BIOLOGICAL CONSEQUENCES OF NO. 2 FUEL OIL SPILLS IN SEMI-NATURAL ECOSYSTEMS

Principal Investigators: Bieri, R. H., and R. J. Huggett
Performing Organization: Virginia Institute of Marine Science, Gloucester Point, Virginia 23062
Supporting Agency: U.S. Environmental Protection Agency, Office of Research and Development, Contract 68-03-0423
Period: 7/73 to 4/76 Funds: $4,980

General fate of oil in the environment, Analysis

The contract provides for research to determine the chemical dynamics, fate and biological effects of oil spilled in an estuarine environment. Spills of No. 2 oil at different dosage levels will be applied to a confined estuarine area containing oysters (Crassostrea virginica) and clams (Mercenaria mercenaria). Sampling and analysis of these organisms will be conducted before and after the spills and at intervals of days throughout the experiment.

Status: The experimental work for the grant (EPA R-803 063-01-0) has been completed. The report should be finished in April, 1976.

Information Source: R. H. Bieri, Virginia Institute of Marine Science, Gloucester Point, Virginia 23062

R-48-76
AN INVESTIGATION TO DETERMINE THE ECOLOGICAL EFFECTS OF OIL SPILLS IN EASTERN COASTAL PLAIN ESTUARIES

Principal Investigator: Bieri, R. H.
Performing Organization: Virginia Institute of Marine Science, Gloucester Point, Virginia 23062
Supporting Agency: American Petroleum Institute, No. 210-75T (FEO-1)
Period: Unknown

Status: This project is currently underway.

Information Source: R. H. Bieri, Senior Marine Scientist, Virginia Institute of Marine Science, Gloucester Point, Virginia 23062

R-49-76

ENVIRONMENTAL QUALITY CRITERIA

Principal Investigators: Carter, V. L., and S. A. London
Performing Organization: U.S. Air Force, Aerospace Medical Research Laboratory, Wright Patterson A.F.B., Dayton, Ohio 45433
Supporting Agency: U.S. Department of Defense, Air Force, No. DF312920
Period: 7/75 to 6/76

Analysis

The pollution potential of aircraft fuels and lubricants and missile propellants and their exhaust products will be determined. Microbial species, plant species and aquatic species will be used to determine the effects, dose relationships and no dose levels of the pollutants. Environmental degradation rates of the pollutants will also be determined.

Status: The studies conducted at the Sanitary Engineering Research Laboratory, University of California, Berkeley, on the pollution effects of jet fuel JP-9 and its components, RJ-4, RJ-5 and methylcyclohexane, are complete. Only some long-term fish tissue retention studies remain to be accomplished for JP-9. Studies are now underway to evaluate the effects of JP-9 and lubrication additives on algae. Progress of these projects was reported in papers presented at the Sixth Environmental Toxicology Conference, 21-23 October 1975.

Reports and Publications

BIOASSAY USING FISH AND AUFWUCHS COMMUNITIES

Jenkins, D., and S. A. Kline. (in press)
Environmental Toxicology Conference, 6th, 1975.

Studies of the toxicity to fish and aufwuchs of jet fuels used by the U.S. Air Force, including JP-4, JP-9 and its components, RJ-4, RJ-5 and methylcyclohexane, are documented. Methods are described for the quantitative analysis of fuel and fuel components in water and their accumulation in fish. The problems associated with the use of compounds of limited solubility in aqueous systems and high volatility are explored, and the variety of techniques for providing compound exposure are presented.

THE TOXICITY TO FISH OF THE JET FUEL JP 9, ITS COMPONENTS RJ 4, RJ 5 AND METHYLCYCLOHEXANE (MCH)

Klein, S. A., D. Jenkins, and R. C. Cooper. (in press)
Environmental Toxicology Conference, 6th, 1975.

The results of fish toxicity studies on JP 9 and its components are presented. Fish toxicity was measured in batch and continuous flow systems using both warm water fish and cold water fish. Studies were conducted on static pools of fuel, fuel emulsions and aqueous fuel solutions. Developmental work was done on the extraction, concentration and gas chromatographic analysis of fuel components in water and fish flesh.

USE OF UNICELLULAR ALGAE FOR EVALUATION OF POTENTIAL AQUATIC CONTAMINANTS

Scherfig, J., and P. S Dixon. (in press)
Environmental Toxicology Conference, 6th, 1975.

This report describes the methods and results used to evaluate the toxic and/or biostimulating effects of jet fuels, lubrication additives, and hydrazines in aquatic freshwater environments. Batch and continuous culture assays were tests used. The Standard Batch Algal Assays appear to be a relatively easy, sensitive and inexpensive method for evaluating chemicals discharged or accidentally spilled in the aquatic environment.

R-50-76

AN INVESTIGATION OF THE EFFECTS OF TAR ON THE FLORA AND FAUNA OF THE ROCKY INTERTIDAL ZONE OF BERMUDA

Principal Investigator: Maynard, N. G.
Performing Organization: Engineering Sciences Laboratory, Harvard University, 40 Oxford St., Cambridge, Massachusetts 02138
Supporting Agency: Unknown
Period: Unknown

The study is in its second year.

Reports and Publications

PELAGIC HYDROCARBONS AND THE ROCKY INTERTIDAL ZONE OF BERMUDA

Maynard, N. G., C. D. Gebelein, and A. Zsolnay. 1976.
Offshore Technology Conference, Houston, Texas, 1976.

R-51-76

NON-NUCLEAR POLLUTANT IMPACTS ON COASTAL BENTHOS

Principal Investigator: Spies, R.
Performing Organization: Lawrence Livermore Laboratory, P.O. Box 808, Livermore, Ca. 94550
Supporting Agency: U.S. Energy Research and Development Administration
Period: Unknown

The project objective is to define the benthic communities in oil seep areas, to contrast them to nearby control situations and to define temporal changes in each. Smaller efforts involve the utilization of hydrocarbons by benthic organisms and the study of potentially harmful types of drilling muds used in offshore drilling.

Status: A project summary on the impact of oil pollution on coastal benthos is presently being written.

Information Source: R. B. Spies, Biomedical & Environmental Research Division, Lawrence Livermore Laboratory, University of California, P.O. Box 808, Livermore, Ca. 94550

R-52-76

EFFECT OF DEGRADED OIL (MICROBIAL) UPON THE FERTILIZATION AND DEVELOPMENT OF SEA URCHIN EGGS

Principal Investigator: Størmer, F. C.
Performing Organization: National Institute of Health, Oslo, Norway
Supporting Agency: Unknown
Period: Unknown

Biological degradation

Part of the research project will be performed at Stazione Zoologica, Napoli, Italy.

R-53-76

THE EFFECT OF TAR ON ROCKY SHORE BOAT BIOTA

Principal Investigator: Zsolnay, A.
Performing Organization: Duke University Marine Laboratory, Beaufort, North Carolina 28516
Supporting Agency: American Petroleum Institute
Period: Unknown

Status: The uptake of hydrocarbons by the rocky shore biota of Bermuda seems generally to be quite small. Heavy uptake is restricted to certain organisms living in areas of extremely heavy tar coverage. No gross morphological aberrations appear to be associated with these organisms. No publications are available at present.

Information Source: A. Zsolnay, Duke University Marine
Laboratory, Beaufort, North Carolina 28516

2. GENERAL EFFECTS

R-54-76
OIL POLLUTION AND BIODEGRADATION IN WATER AND GROUNDWATER

Principal Investigator: Fuksa, J.
Performing Organization: Stavební geologie, Biological Laboratory,
Na Kovárne 4, 10100 Prague,
10 Czechoslovakia
Supporting Agency: Unknown
Period: Unknown

Biological degradation

Summary not available.

R-55-76
EFFECTS OF OIL SPILL--CASCO BAY, MAINE

Principal Investigator: Unknown
Performing Organization: State Department of Natural Resources,
Maine
Supporting Agency: U.S. Department of the Interior
Period: 7/74 to 1/76

This project is a continuation of investigations by the State of Maine Department of Natural Resources of the long-term effects of a No. 6 oil spill in Casco Bay, Maine.

D. EFFECTS OF OIL PROSPECTING AND PRODUCTION

1. BIOLOGICAL EFFECTS

R-56-76
EFFECT OF REFINERY EFFLUENTS ON AQUATIC LIFE

Principal Investigators: Buikema, A., J. Cairns, and K. Dickson
Department: Biology
Performing Organization: Virginia Polytechnical Institute and State University, School of Arts and Sciences, Burruss Hall, Blacksburg, Virginia 24061
Supporting Agency: American Petroleum Institute
Period: 7/74 to 12/75

A number of freshwater and marine organisms will be surveyed to discover a biological monitor for refinery effluents. The object is to develop a simple, compact, inexpensive technique to be used by nonbiologists. Freshwater organisms have been surveyed; marine work began in early 1975.

2. PHYSICAL EFFECTS

R-57-76
MISSISSIPPI DELTA FRONT STABILITY STUDY

Principal Investigator: Unknown
Performing Organization: U.S. Geological Survey, Louisiana State University
Supporting Agency: U.S. Department of the Interior
Period: 8/75 to 8/76

The project includes a study of the factors influencing delta-front sediment stability. This program will quantify such parameters and will provide a means of rapidly analyzing for, and determining the magnitude of potential hazards.

3. GENERAL EFFECTS

R-25-76
ATLANTIC/ALASKAN OCS PETROLEUM STUDY

Principal Investigators: Moore, S. F., J. W. Devanney, and J. B. Lassiter
Specialty: Civil Engineering
Performing Organization: Massachusetts Institute of Technology, School of Engineering, Cambridge, Massachusetts 02139
Supporting Agency: U.S. Department of Health, Education and Welfare, Social and Rehabilitation Service, Community Services Administration
Period: 7/75 to 6/76

General fate of oil in the environment, General effects of oil pollution

This study concerns potential effects of oil prospecting and production on the OCS of the Atlantic and the Gulf of Alaska. Oil spill tracking, weathering and effects will be investigated. From the analysis of hypothetical oil discharges, high risk areas will be identified.

Reports and Publications

OFFSHORE OIL SPILLS AND THE MARINE ENVIRONMENT

Moore, S. F. 1976.
Technology Review 78(4):61-67.

The author discusses a study prepared for the Council on Environmental Quality to assess potential biological effects of hypothetical discharges. The study did not predict spill effects in quantitative terms; however, by studying the initial impacts of a spill and the recovery period, rough "order-of-magnitude" estimates could be made. Results from studies of hypothetical offshore drilling sites along the Atlantic and Alaskan coasts revealed that none of the hypothesized spills from the Atlantic offshore sites is expected to cause significant biological damage to nearshore habitats. No conclusions were drawn regarding the effects of spills on the Alaskan coast due to insufficient data.

POTENTIAL BIOLOGICAL EFFECTS OF HYPOTHETICAL OIL DISCHARGES IN THE ATLANTIC COAST AND GULF OF ALASKA

Moore, S. F., G. R. Chirlin, C. J. Puccia, and B. P. Schrader. 1974.
Massachusetts Institute of Technology Sea Grant Program report, MITSG 74-19. 121 p.

The principal objective of the study was to assess potential biological effects of hypothetical oil discharges. The study did not predict spill effects in quantitative terms; however, by studying the initial impacts of a spill and the recovery period, rough order of magnitude estimates could be made. Results from studies of hypothetical offshore drilling sites along the Atlantic and Alaskan Coasts revealed that sites in the Baltimore Trough and on Georges Bank are least vulnerable to environmental impacts of oil. Sites south of Long Island, New York and in the Georgia Embayment pose higher environmental risks. No conclusions were drawn regarding effects of spills from hypothetical drilling sites in the Gulf of Alaska.

Information Source: S. F. Moore, Massachusetts Institute of Technology, School of Engineering, Cambridge, Massachusetts 02139

R-58-76
MESA PUGET SOUND

Principal Investigator: Harris, H. S.
Performing Organization: U.S. Department of Commerce, Environmental Research Labs, Boulder, Colorado 80302
Supporting Agency: U.S. National Oceanic and Atmospheric Administration, Environmental Research Labs, No. 87121445
Period: 7/74 to 6/75 Funds: $265,000

An ecological model of Puget Sound will be developed in order to evaluate man's impact on the marine waters of the region. Major topics will be the environmental problems associated with petroleum transportation and refining and waste water discharges.

Status: The project is current and field work is getting underway.

Information Source: H. S. Harris, U.S. Department of Commerce, NOAA, MESA Puget Sound Project, 3711 15th Ave. NE, Seattle, Washington 98105

E. FATE OF OIL IN THE ENVIRONMENT

1. BIOLOGICAL DEGRADATION

R-59-74 (renewal)
NAVY ENVIRONMENT: BIODEGRADATION OF OIL POLLUTANTS BY YEAST AND YEAST LIKE FUNGI

Principal Investigators: Ahearn, D. G., and W. L. Cook
Department: Physics
Performing Organization: Georgia State University, School of Arts and Sciences, 33 Gilmer St. S.E., Atlanta, Georgia 30303
Supporting Agency: U.S. Department of Defense, Navy, DN123203, Contract N00014-71-C-0145
Period: 7/75 to 10/76

Labelling and gas chromatographic techniques are being used to study the effects of oil soluble toxicants on yeast growth and oil emulsification. Field procedures are being developed to test the effects of yeast on oil degradation and removal from bilge systems. Possible pathogenicity of selected fungi toward marine and estuarine organisms is being assessed.

Status: The research contract has been continued until December 1, 1976.

Reports and Publications

FUNGAL DEGRADATION OF OIL IN THE MARINE ENVIRONMENT

Ahearn, D. G., and S. P. Meyers. [date unknown]
[citation unknown]

Studies indicate that hydrocarbonoclastic yeasts are widespread in the neritic environment and may occur in high densities in surface slicks. Following an oil spill, growth of certain indigenous yeasts on surface slicks is selectively stimulated, although a sustained increase in yeast biomass does not occur in oil-contaminated waters. Hydrocarbonoclastic molds also occur in marine habitats but their relationship to natural slicks is unknown. Considerable attention is being given to microbial species which, when introduced to oil-contaminated environments, can rapidly accelerate the degradation of oil.

DENSITIES OF BACTERIA AND FUNGI IN COASTAL SURFACE FILMS AS DETERMINED BY A MEMBRANE-ADSORPTION PROCEDURE

Crow, S. A., D. G. Ahearn, W. L. Cook and A. W. Bourquin.
1975.
Limnology and Oceanography 20(4):644-646.

A simple membrane-adsorption technique for counting microorganisms in surface slicks is described. The procedure gave bacterial and fungal populations several orders of magnitude greater than those previously reported for surface oil slicks.

PHYSIOLOGICAL AND DNA CHARACTERIZATION OF CANDIDA MALTOSA, A HYDROCARBON-UTILIZING YEAST

Meyer, S. A., K. Anderson, R. E. Brown, M. Th. Smith,
D. Yarrow, G. Mitchell, and D. G. Ahearn. 1975.
Arch. Microbiology 104:225-231.

Selected hydrocarbon-utilizing yeasts classified as *Candida sake* van Uden et Buckley were examined for their physiological, morphological and immunological patterns and their DNA relatedness. All evidence, in particular DNA reassociations, demonstrates that *Candida cloacae* Komogata, Nakase et Katsuya, *C. maltosa* Komagata, Nakase et Katsuya and *C. subtropicalis* Nakase, Fukazawa et Tsuchiya are synonymous and distinct from *C. sake* van Uden et Buckley and *C. tropicalis* Berkhout. Distinguishing properties are outlined.

Information Source: D. G. Ahearn, Professor of Microbiology,
Georgia State University, 33 Gilmer St., S.E.,
Atlanta, Georgia 30303

R-068-74 (renewal)

NAVY ENVIRONMENT: BIODEGRADATION OF OIL SLICKS IN THE MARINE ENVIRONMENT

Principal Investigator: Bartha, R.
Specialty: Microbiology and Biochemistry
Performing Organization: Rutgers The State University, School of Arts and Sciences, Old Queens Bldg., New Brunswick, New Jersey 08903
Supporting Agency: U.S. Department of Defense, Navy, DN023175, Contract N00014-67-A-0115-0005
Period: 7/75 to 6/76 Funds: $17,981

Microorganisms are being isolated from oil-soaked beach and soil samples to find oil degrading species. A Warburg respirometer is being used to determine the effect of oleophilic fertilizers on the growth rate. The rate of petroleum degradation may be increased by bacterial mutants that use both normal and branched alkanes. Methods of stimulating biodegradation are being investigated.

Reports and Publications

BIODEGRADATION OF SOME POLYNUCLEAR AROMATIC PETROLEUM COMPONENTS BY MARINE BACTERIA

Dean-Raymond, D., and R. Bartha. 1975.
Developments in Industrial Microbiology 16:97-110.

The metabolism of polynuclear aromatic hydrocarbons (PAH) by six bacterial strains isolated from oil-polluted waters was studied using various chromatographic and spectrometric techniques. All six strains grew on naphthalene, 2-methylnaphthalene and 2-ethylnaphthalene as sole sources of carbon and energy. Studies of the metabolism of other PAH are discussed.

HYDROCARBON METABOLISM BY BREVIBACTERIUM ERYTHROGENES: NORMAL AND BRANCHED ALKANES

Pirnik, M. P., R. M. Atlas, and R. Bartha. 1974.
Journal of Bacteriology 119(3):868-878.

The metabolism of branched- and straight-chain alkanes by B. erythrogenes occurs in two distinct pathways. The degradation pathways of pristane and other branched alkanes are studied. Results suggest an inducible dicarboxylic acid pathway for degradation of branched-chain alkanes.

Information Source: R. Bartha, Rutgers The State University,
Cook College, Department of Biochemistry
and Microbiology, P.O. Box 231, New Brunswick,
New Jersey 08903

R-116-74 (renewal)
MICROBIAL METABOLISM OF HYDROCARBONS UNDER LOW TEMPERATURE MARINE CONDITIONS

Principal Investigators: Traxler, R. W., and A. M. Cundell
Performing Organization: Rhode Island University, Department of Plant Pathology-Entomology, Kingston, Rhode Island 02881
Supporting Agency: Office of Naval Research

The bacteria used in this study come from environments with a temperature range from -2.5 to 20°C. The fine structure of cells grown on hydrocarbons will be analyzed to determine the character of the intracellular deposit. Data from a Narragansett Bay fuel oil spill will be compared to the laboratory data.

Reports and Publications

OIL POLLUTION AND OFFSHORE FIELD DEVELOPMENT

Cundell, A. M. 1972.
Journal New Zealand Institute of Chemistry 36:184-187.

The environmental impact of offshore oil production within New Zealand waters must be evaluated. The weathering and degradation of oil, its effects, cleanup and safety procedures and oil movement are topics reviewed.

THE MORPHOLOGY AND ULTRASTRUCTURE OF A HYDROCARBON-DEGRADING *PENICILLIUM* SP. GROWN ON N-HEXADECANE OR PEPTONE

Cundell, A. N., W. C. Mueller, and R. W. Traxler. 1976.
Applied and Environmental Microbiology (in press)

THE ISOLATION AND CHARACTERIZATION OF HYDROCARBON-UTILIZING BACTERIA FROM CHEBABUCTO BAY, NOVA SCOTIA

Cundell, A. M., and R. W. Traxler. 1973.
Conference on the Prevention and Control of Oil Spills, 1973.
p. 421-426.

Enrichment culture techniques were used to isolate hydrocarbon-utilizing bacteria from sediment and seawater samples of Chebabucto Bay, Nova Scotia. The isolates were screened on various hydrocarbon substrates to form a utilization profile. Growth rates, generation times and lag times were determined for each isolate on the various substrates.

PSYCHROPHILIC HYDROCARBON-DEGRADING BACTERIA FROM NARRAGANSETT BAY, RHODE ISLAND

Cundell, A. M., and R. W. Traxler. 1976.
Material und Organismen (in press)

THE PERSISTENCE AND BIODEGRADATION OF SPILLED RESIDUAL FUEL OIL ON AN ESTUARINE BEACH

Pierce, J. H., A. M. Cundell, and R. W. Traxler. 1975.
Applied Microbiology 29:646-652.

Hydrocarbon-degrading bacteria increased from days 4 to 16 after an oil spill on a Rhode Island beach, and maintained a population for a year. The concentration of petroleum hydrocarbons declined rapidly to a low after one year. Biodegradation in the winter was less than 1 μg/gm dry sediment/day.

Information Source: Dr. A. M. Cundell, Fellow in Applied Biology,
Harvard University, Engineering Sciences
Laboratory, 40 Oxford St., Cambridge,
Massachusetts 02138

R-227-74 (renewal)

BIODEGRADATION OF OIL IN SEAWATER FOR NAVAL POLLUTION CONTROL

Principal Investigators: O'Neill, T. B., and D. B. Chan
Performing Organization: U.S. Navy, Civil Engineering Laboratory,
Point Mugu, Port Hueneme, California 93041
Supporting Agency: U.S. Department of Defense, Navy, DN144052
Period: 7/75 to 6/76

Cleanup and recovery

The objective of this research is to isolate microorganisms which can efficiently degrade petroleum and be grown in large quantities. The research will include a literature review, isolation of microbes from areas of southern California where oil leakage is common, increasing their metabolic activity in pure or mixed cultures, and mass producing suitable organisms in order to eliminate oil through biodegradation.

R-59-76

STUDY OF METABOLIC PATHWAYS OPERATIVE IN THE DEGRADATION OF PHENOLIC COMPOUNDS BY THERMOPHILIC BACTERIA

Principal Investigator: Buswell, J. A.
Performing Organization: Department of Biology, Paisley College
of Technology, High St., Paisley,
Renfrewshire, PA1 2BE, Scotland
Supporting Agency: Unknown
Period: Unknown

Biological degradation

Status: The project is continuing and is currently being expanded to include studies of the catabolic pathways by which a wide range of aromatic compounds are dissimilated by thermophilic microorganisms.

Reports and Publications

THE *META*-CLEAVAGE OF CATECHOL BY A THERMOPHILIC BACILLUS SPECIES

Buswell, J. 1974.
Biochemical and Biophysical Research Communications 60(3): 293-301.

UTILIZATION OF PHENOL AND CRESOLS BY *BACILLUS STEAROTHERMOPHILUS* STRAIN PH24

Buswell, J. A., and D. G. Twomey. 1975.
Journal of General Microbiology 87:377-379.

METABOLISM OF PHENOL AND CRESOLS BY *BACILLUS STEAROTHERMOPHILUS*

Buswell, J. A. 1975.
Journal of Bacteriology 124(3):1077-1083.

Information Source: J. A. Buswell, Paisley College of Technology,
Department of Biology, High St., Paisley,
Renfrewshire PA1 2BE, Scotland

R-60-76

THE ROLE OF INDIGENOUS AQUATIC AND TERRESTRIAL MICROORGANISMS IN CRUDE OIL DEGRADATION AT LOW TEMPERATURES, AND THE EFFECT OF CRUDE OIL ON POPULATION DYNAMICS

Principal Investigators: Gordon, R. C., and E. Sparrow
Performing Organization: U.S. Environmental Protection Agency, Arctic Environmental Research Laboratory, College, Alaska 99701
Supporting Agency: U.S. Environmental Protection Agency
Period: 1975 to 1978?

Status: The study is in the first year of what will be a three-year study. The microbiological aspects of controlled hot oil spills in a taiga area underlain with permafrost will be examined along with parallel studies in the aquatic environment. Field and laboratory work on the terrestrial phase is just beginning. Laboratory work with indigenous microorganisms from subarctic streams is also in its initial stages. No reports are available at present.

Information Source: R. C. Gordon, Research Microbiologist,
U.S. Environmental Protection Agency,
Arctic Environmental Research Laboratory,
College, Alaska 99701

2. PHYSICAL CHANGES OF OIL

R-31-76
EVAPORATION OF OIL SPILLS ON WATER

Principal Investigators: Palmer, L. L., and H. S. Fogler
Performing Organization: Chevron Oil Field Research Co., La Habra, Ca., University of Michigan, Ann Arbor, Mi.
Supporting Agency: Standard Oil Company of California
Period: 1974 to 1976

A theoretical and laboratory experimental study is being conducted to develop a simple mathematical model for the evaporation of oil spills on water. The model is based on information available in the literature on oil spill evaporation.

Status: The study to develop a simple mathematical description has been completed. A computer program has been developed to model the mathematical description. Brief laboratory experiments have been conducted and are planned for use in confirming the accuracy of the computer model. Completion of the project is scheduled for late 1976.

Information Source: L. L. Palmer, Chevron Oil Field Research Company, P.O. Box 446, La Habra, Ca. 90631

3. GENERAL FATE OF OIL

R-076-74 (renewal)
TRANSFER OF PETROLEUM RESIDUES IN SARGASSUM COMMUNITIES AND THE WATERS OF THE SARGASSO SEA

Principal Investigators: Butler, J. N., and B. F. Morris
Performing Organization: Bermuda Biological Station for Research, St. George, St. George West, Bermuda
Supporting Agency: National Science Foundation, Division of National and International Programs, GX-32883A#1
Period: 5/75 to 4/76 Funds: $51,550

Physical changes of oil in the environment, Source identification, Sampling, Analysis, Monitoring

An investigation of the uptake and transfer of petroleum hydrocarbons through the different trophic levels of the Sargassum Sea communities.

Status: The project is currently funded through April 30, 1976.

In preparation

HYDROCARBONS IN SARGASSUM AND ITS ASSOCIATED FAUNA

Cadwallader, J., and J. N. Butler

Full data from gas chromatographic analysis of hydrocarbons in *Sargassum* and seven of its larger associated fauna will be presented in tabular form. Statistical measures of the variability of these hydrocarbon analyses and quantitative correlation between replicate samples will be given. Emphasis will be on the distinction between petroleum and biogenic hydrocarbons.

THE FOOD WEB OF THE SARGASSUM COMMUNITY

Morris, B. F., and J. Geiselman

Analysis of gut contents of preserved specimens, direct observation of feeding behavior of live organisms, and examination of the gut and fecal contents of live organisms yields information summarized as a food web matrix. Quantitative data on these observations and the effect of environmental conditions will be reported.

Reports and Publications

EVAPORATIVE WEATHERING OF PETROLEUM RESIDUES: THE AGE OF PELAGIC TAR

Butler, J. N. 1975.
Marine Chemistry 3(1):9-21.

This paper discusses a simple semiquantitative model of evaporative weathering and its use in determining the age of individual tar lumps. Application of the model to gas chromatograms of pelagic tar lumps collected near Bermuda indicates that most of these lumps were formed by fragmentation of much larger and older masses, some within one day of collection time.

PELAGIC TAR

Butler, J. N. 1975.
Scientific American 232(6):90-97.

Tarry residues of petroleum, probably formed mainly by the discharge of waste from oil tankers, are picked up by fine nets everywhere in the ocean. The weathering of these lumps and the organisms associated with them are being studied. The effect of petroleum wastes on marine organisms is still not well known.

TRANSFER OF PETROLEUM RESIDUES FROM SEA TO AIR: EVAPORATIVE WEATHERING (in press)

Butler, J. N. 1976.
Marine Pollutant Transfer. H. E. Windom and R. A. Duce (eds.). D. C. Heath and Co. (1976).

This paper develops a simple semiquantitative model of evaporative weathering which predicts the transport of petroleum components to the atmosphere from the sea surface. The rate of evaporative weathering of a component of crude oil residue is assumed to be proportional to its equilibrium vapor pressure and to the amount remaining in the sample. The rate of transfer from the sea surface by evaporation is estimated to be somewhat less than half the rate of petroleum input: approximately 30 mg/m^2 yr in the Sargasso Sea.

NORMAL PARAFFIN PROFILES OF PELAGIC TAR SAMPLES FROM THE MARMAP SURVEY

Butler, J. N., and J. C. Harris. 1975.
Marine Chemistry 3(1):1-7.

Pelagic tar samples, collected from 20 stations on cruises from the MARMAP Survey, were analyzed by gas chromatography to obtain normal paraffin profiles in the range from C_{10} to C_{35}, and a qualitative indication of the relative amount of other volatile compounds in that range. The samples were all weathered residues of waxy paraffinic crude oils and were similar to samples collected from the Sargasso Sea near Bermuda.

QUANTITATIVE MONITORING AND AVAILABILITY OF PELAGIC TAR IN THE NORTH ATLANTIC

Butler, J. N., and B. F. Morris. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop, National Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.). NBS Special Publication No. 409. p. 75-78.

Sampling with a neuston net for pelagic tar gives results that vary by a factor of 10. Thus, elaborate flow measurements, etc., are not useful. The IOC-WMO recommendation that dry weight be determined involves unnecessary labor. Wet weight measurements are adequate.

PELAGIC TAR FROM BERMUDA AND THE SARGASSO SEA

Butler, J. N., B. F. Morris, and J. Sass. 1973.
Bermuda Biological Station for Research, Special Publication No. 10. 346 p.

From surveys of pelagic tar lumps in the Atlantic Ocean, it has been reported that highest concentrations occur in the Sargasso Sea (2-40 mg/m^2). The possible sources of tar deposits on Bermuda beaches and the chemical composition of tar lumps in the Sargasso Sea are discussed.

PETROLEUM RESIDUES IN THE SARGASSO SEA AND ON BERMUDA BEACHES

Morris, B. F., and J. N. Butler. 1973.
Prevention and Control of Oil Spills. Proceedings of Joint Conference on Prevention and Control of Oil Spills, 13-15 March 1973, Washington, D.C. 4172. p. 521-572.

'Tar lumps' amount to 86,000 metric tons in the Northwest Atlantic, most in the Sargasso Sea. Chemical characteristics imply that the source is crude oil sludge from tanker washings. Degradation is on the order of years.

TRANSFER OF PARTICULATE HYDROCARBON MATERIAL FROM THE OCEAN SURFACE TO THE WATER COLUMN (in press)

Morris, B. F., J. N. Butler, T. D. Sleeter, and J. Cadwallader. 1976.
Marine Pollutant Transfer. H. E. Windom and R. A. Duce (eds.).
D. C. Heath and Co. (1976).

Seawater samples collected in the Sargasso Sea near Bermuda between 1 and 100 meters depth were filtered, filters were examined and then extracted with pentane and benzene, and filter extracts were analyzed by gas chromatography. The extracts showed mainly normal alkanes in the range from 25 to 40 carbons, with no odd-carbon predominance, and an unresolved envelope in about half the samples. The total mass of black or brown "tar-like" particles (10 to 500 μm) between these depths is estimated to be about 40 $\mu g/m^2$ of ocean surface, four times the standing crop of larger tar lumps at the sea surface. From these analyses pelagic tar appears to be a transient form of petroleum residue which continues into the water column as small particles.

PELAGIC TAR IN THE MEDITERRANEAN SEA, 1974-75

Morris, B. F., J. N. Butler, and A. Zsolnay. 1975.
Environmental Conservation 2(4):275-282.

From 12/6/74 to 1/20/75, the 'R/V Westward' circumnavigated the Mediterranean Sea and took quantitative samples of pelagic tar at 48 stations. These samples were compared with samples collected from a similar survey made in 1969 by the 'R/V Atlantis.' The total standing stock of pelagic tar in the Mediterranean is lower than in 1969, due to decreased pollution of the eastern basin. With the reopening of the Suez Canal, changes in the amounts of tar should continue to be monitored.

TRANSFER OF PETROLEUM AND BIOGENIC HYDROCARBONS IN THE SARGASSUM COMMUNITY (in press)

Morris, B. F., J. Cadwaller, T. Geiselman, and J. N. Butler. 1976.
Marine Pollutant Transfer. H. E. Windom and R. A. Duce (eds.).
D. C. Heath and Co. (1976)

Samples of Sargassum and its associated fauna were collected and extracted, and the non-polar hydrocarbons were analyzed by gas chromatography. Total hydrocarbon contents varied from 8 to 3400 μg/g dry weight, and the ratio of petroleum to biogenic hydrocarbons varied from 12 to 600. High concentrations of petroleum hydrocarbons present were probably ingested directly as tar particles. Except for the relatively lower content of the Sargassum, position did not correlate with petroleum hydrocarbon content.

PELAGIC TAR IN THE CARIBBEAN AND EQUATORIAL ATLANTIC, 1974

Sleeter, T. D., B. F. Morris, and J. N. Butler. 1976.
Deep Sea Research.

Pelagic tar was sampled at 61 stations in the Caribbean region and 31 stations in the eastern north and equatorial Atlantic. Tar densities in the Caribbean and Canary current region are similar to previously recorded densities; Atlantic densities were significantly lower than others have recorded. Data suggest that altnough less tar has been measured in the Caribbean than in the Sargasso Sea, comparable quantities of tar in unit time probably pass through both regions.

QUANTITATIVE SAMPLING OF PELAGIC TAR IN THE NORTH ATLANTIC, 1973

Sleeter, T., D. F. Morris, and N. Butler. 1974.
Deep-Sea Research 21(9):773-775.

Pelagic tar has been quantitatively collected in the western Sargasso Sea and the eastern North Atlantic. Heyerdahl observed exceptionally large amounts of tar in 1969 and 1970; Langmuir currents may have concentrated the tar into windrows.

Information Source: J. N. Butler, Division of Engineering and Applied Physics, Harvard University, Pierce Hall, 29 Oxford St., Cambridge, Massachusetts 02138

R-303-75
FATES AND EFFECTS OF OIL AND OIL COMPOUNDS ON MARINE COASTAL ECOSYSTEMS

Principal Investigators: Templeton, W. L., C. I. Gibson, J. R. Vanderhorst, and R. M. Bean
Performing Organization: Battelle Memorial Institute, P.O. Box 999, Richland, Washington 99352

Supporting Agency: U.S. Energy Research and Development
Administration, Biomedical & Environmental
Research Division, Contract AT(45-1)-1830
Period: 7/74 to 6/75

General effects of oil pollution

Biological and chemical studies are being integrated into a program to determine the fate of oil components in marine environments and examine the complex effects of those components on community structure. A three-month chronic exposure of an experimental intertidal community to oil was undertaken.

Reports and Publications

QUALIFICATIONS FOR TESTING OF OIL SPILL REMOVAL/RECOVERY EQUIPMENT AND SYSTEMS

Anon.
Battelle-Northwest, Engineering Technology Department,
Richland, Washington 99352

Battelle-Northwest has been active in technical areas concerning the testing of oil spill removal/recovery equipment. The test site consists of a large concrete waterbasin, wave generator, wind generator, towing trolleys, etc. Several evaluations have been done on full-size prototype and production model skimmers.

EFFECTS OF PETROLEUM HYDROCARBONS ON THE GROWTH OF MARINE ORGANISMS (in press)

Anderson, J. W. 1975.
Workshop on Petroleum Hydrocarbons in the Marine Environment. International Council for the Exploration of the Sea, Special Publication

LABORATORY STUDIES ON THE EFFECTS OF OIL ON MARINE ORGANISMS: AN OVERVIEW

Anderson, J. W. 1975.
American Petroleum Institute, No. 4249. 70 p.

OIL BIOASSAYS WITH THE AMERICAN OYSTER *CRASSOSTREA VIRGINICA* (GMELIN) (in press)

Anderson, J. W., and R. D. Anderson. 1975.
National Shellfisheries Association, Proceedings.

ACCUMULATION AND RELEASE OF PETROLEUM HYDROCARBONS BY EDIBLE MARINE ANIMALS (in press)

Anderson, J. W., and J. M. Neff. 1974(?)
Recent Advances in the Assessment of the Health Effects of Environmental Pollution.

TOXICITY OF WATER-SOLUBLE FRACTIONS FOUR TEST OILS FOR THE POLYCHAETOUS ANNELIDS, NEANTHES ARENACEODENTATA AND CAPITELLA CAPITATA (in press)

Anderson, J. W., and S. S. Rossi. 1976.
Environmental Pollution

STUDIES ON THE EFFECTS OF TWO OIL COLLECTING AGENTS ON AQUATIC COMMUNITIES OF LAKE MARACAIBO

Sutton, E. A., and R. C. Arnett. 1974.
Battelle-Northwest, Richland, Washington

STUDY OF EFFECTS OF OIL DISCHARGES AND DOMESTIC AND INDUSTRIAL WASTE WATERS ON THE FISHERIES OF LAKE MARACAIBO, VENEZUELA

Sutton, E. A., R. C. Arnett, W. L. Templeton, and R. M. Bean. 1974.
Battelle-Northwest, Richland, Washington

THE ROLE OF DISPERSION IN FUEL OIL BIOASSAY (in press)

Vanderhorst, J. R., C. I. Gibson, and L. J. Moore. 1976.
Bulletin of Environmental Contamination and Toxicology

FIELD AND LABORATORY STUDIES TO OBTAIN A COMPARATIVE BASELINE FOR ASSESSING THE IMPACT OF REFINERY DISCHARGE AND POTENTIAL OIL SPILLAGE ON THE CHERRY POINT ENVIRONS. VOL. IV. BIOASSAY STUDIES

Vanderhorst, J. R., and P. Wilkinson. 1974.
Final report to Atlantic Richfield Company, Battelle-Northwest, Richland, Washington

Information Source: George N. Bukota, Battelle Pacific Northwest
Laboratories, Battelle Boulevard, Richland,
Washington 99352

R-304-75
INPUTS, FATES, AND EFFECTS OF PETROLEUM IN MARINE ENVIRONMENTS

Principal Investigator: Vetter, R. C.
Performing Organization: National Academy of Sciences,
2101 Constitution Ave., N.W., Washington,
D.C. 20037
Supporting Agency: U.S. Environmental Protection Agency, Office
of Research and Development, 802476 Contract
72P21484
Period: 7/74 to 6/75

Biological effects of oil pollution, Biodegradation, Analysis

The contract provides for the organization by the Ocean Affairs Board, National Academy of Sciences, of a Workshop on Inputs, Fates, and Effects of Petroleum in the Marine Environment. Major objectives of the Workshop will be to quantify the inputs of petroleum in the oceans, compare analytical techniques, determine the fates of petroleum in the marine environment, and evaluate the effects of oil spills on coastlines, biota, marine resources and human health.

Reports and Publications

PETROLEUM IN THE MARINE ENVIRONMENT

National Academy of Sciences. 1975.
Washington, D.C., National Academy of Sciences, 1975. 107 p.
Workshop on Inputs, Fates, and the Effects of Petroleum in the Marine Environment, Airlie House, Virginia, 1973.

Topics discussed at the workshop include: sources of oil entering the sea, petroleum inputs to the marine environment, analytical techniques to determine oil contamination in marine organisms and hydrocarbon biodegradation kinetics. It was concluded that much more research regarding the fates and effects of petroleum hydrocarbons in the marine environment is needed.

Information Source: R. C. Vetter, National Academy of Sciences,
2101 Constitution Ave., N.W., Washington,
D.C. 20037

R-61-76
CURRENT MODELING IN EASTERN GULF OF MEXICO

Principal Investigator: Unknown
Performing Organization: National Oceanic and Atmospheric
Administration, Atlantic Oceanic and
Meteorological Laboratory

Supporting Agency: U.S. Department of the Interior
Period: 8/74 to 10/77

Physical changes of oil in the environment

This project involves the development by NOAA of a mathematical computer simulation model of the prevalent current patterns and water mass movements in the Gulf of Mexico. This contract is a part of the Department of Interior's OCS environmental program related to oil and gas exploration and development

R-62-76

CHARACTERISTICS AND STABILITY OF THE COLLOIDAL MATERIAL ACCOMMODATING HYDROCARBONS IN THE OPEN OCEAN

Principal Investigator: Zsolnay, A.
Performing Organization: Duke University Marine Laboratory,
Beaufort, North Carolina 28516
Supporting Agency: Office of Naval Research
Period: Unknown

Work on this grant has only been initiated recently. Results are still too preliminary to be announced.

R-63-76

THE DISTRIBUTION AND PHYSICAL STATE OF HYDROCARBONS IN AN OCEANIC WATER COLUMN

Principal Investigator: Zsolnay, A.
Performing Organization: Duke University Marine Laboratory,
Beaufort, North Carolina 28516
Supporting Agency: National Science Foundation
Period: Unknown

Status: Hydrocarbon values found off Bermuda have been extremely low, averaging about 0.3 μg/l for petrogenic hydrocarbons and 0.1 μg/l for biogenic hydrocarbons. Most of the hydrocarbon material is to be found in the colloidal fraction. Microscopic tar particles have also been found in the water column at a concentration of about 0.04 μg/l. No publications are available at the present time.

Information Source: A. Zsolnay, Duke University Marine Laboratory,
Beaufort, North Carolina 28516

SECTION III. CURRENT CONFERENCES

*Feb. 2-14 Conference of Plenipotentiaries Convened to Adopt a Draft Framework Convention for the Protection of the Marine Environment Against Pollution in the Mediterranean, Barcelona, Spain, 1976.
Sponsored by the UN Environmental Programme, UN System Agencies.

FFI contact P. S. Thacher, UNEP, Palais des Nations,
CH-1211 Geneva 10, Switzerland

Feb. 23-26 American Chemical Society Middle Atlantic Regional Meeting, 10th, Philadelphia, Pennsylvania, 1976.

Oil Pollution Related Papers

Symposium on Petroleum Hydrocarbons in Aquatic Environments

No. 1
PETROLEUM HYDROCARBONS IN AQUATIC ENVIRONMENTS
Weiss, F. T.

No. 2
SEPARATION AND CLASSIFICATION OF HYDROCARBON POLLUTANTS
Sabatino, T. F., J. V. Hunter, and M. MacKenzie

No. 3
OCCURRENCE AND DISTRIBUTION OF PHENOLICS IN THE DELAWARE ESTUARY
Hunt, G. T., S. D. Faust, and W. H. Clement

No. 4
EARLY WEATHERING OF SOUTH LOUISIANA CRUDE OIL IN THE MARINE ENVIRONMENT
Lefcourt, P.

No. 5
ENVIRONMENTAL PHOTOCHEMISTRY OF PETROLEUM PRODUCTS
Larson, R. A., D. W. Blankenship, and L. L. Wash

No. 6
ADVANCED TREATMENT OF PETROLEUM REFINERY WASTEWATER
Zogorski, J.

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*Additional information not available at time of publication

No. 8
EFFECTS OF PHENOLS ON ESTUARINE INVERTEBRATES
Tripp, M. R.

No. 9
PRELIMINARY STUDY OF THE TOXIC EFFECTS OF IRRADIATED VS. NONIRRADIATED WATER-SOLUBLE FRACTIONS OF NO. 2 FUEL OIL ON FIVE AQUATIC ORGANISMS
Scheier, A.

No. 10
EFFECTS OF PETROLEUM HYDROCARBONS ON OYSTER LARVAE
Haskins, H.

Symposium on Characterization of Pollution in the Marine Environment

No. 11
POLLUTION OF THE COASTAL OCEANS
Segar, D. A.

No. 14
ANALYSIS OF PETROLEUM HYDROCARBONS IN MARINE SAMPLES
Farrington, J. W.

FFI contact American Chemical Society, 10th MARM, 236 Spruce St., Department of Chemistry, University of Pennsylvania, Philadelphia, Pennsylvania 19174

Mar. 1-5 Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, 27th, Cleveland Convention Center, Cleveland, Ohio, 1976.
Sponsored by Society for Analytical Chemists of Pittsburgh; Spectroscopy Society of Pittsburgh.

Oil Pollution Related Papers

Oil Identification Symposium I

No. 319
APPLICATION OF A NEW SULFUR DETECTOR TO QUANTITATIVE OIL SPILL IDENTIFICATION
Flanigan, G. A., D. W. May, and A. P. Bentz

No. 320
LIQUID CHROMATOGRAPHIC IDENTIFICATION OF OILS BY SEPARATION OF THE METHANOL EXTRACTABLE FRACTION
Saner, W. A., and G. E. Fitzgerald

No. 321
ADVANCES IN OIL SPILL IDENTIFICATION BY FIELD IONIZATION MASS SPECTROMETRY
Anbar, M., A. Scott, and M. Scolnick

No. 322
WEATHERED PETROLEUM-PROBABILITY OF IDENTIFICATION BY INFRARED SPECTROSCOPY
Brown, C. W., M. Ahmadjian, and P. F. Lynch

No. 323
A PRELIMINARY LOOK AT MICROPROCESSING INFRARED DATA FOR OIL IDENTIFICATION
Mar, T. L., V. M. Westervelt, and A. P. Bentz

No. 324
A FIELD METHOD FOR NATURAL SEEP OIL DISCRIMINATION BY INFRARED SPECTROSCOPY
Eastwood, D., and D. F. Grant

No. 325
STUDIES OF PETROLEUM SAMPLE IDENTIFICATION USING PATTERN RECOGNITION TECHNIQUES
Clark, H. A., and P. C. Jurs

No. 326
MULTIVARIATE STATISTICAL APPROACH TO THE IDENTIFICATION OF OILS
Mattson, J. M., M. J. Spencer, and S. A. Starks

No. 327
ANALYSIS OF FLUORESCENCE SPECTRA FOR OIL SPILL IDENTIFICATION
Starks, S. A., and M. Curtis

Oil Identification - Symposium II

No. 401
IDENTIFICATION OF CRUDES AND LUBRICATING OILS BY LOW TEMPERATURE LUMINESCENCE
Fortier, S. A., and D. Eastwood

No. 402
OIL FINGERPRINTING BY PHOSPHORESCENCE, A FEASIBILITY STUDY
Hanks, J. A., and D. Eastwood

No. 403
THE IMPORTANCE OF SOLVENT COMPENSATION IN OIL SPILL IDENTIFICATION
Helman, D. L., and R. A. Passwater

No. 404
OIL FINGERPRINTING USING DOUBLE-BEAM FLUORESCENCE SPECTRA
Sheridan, J. A., and J. R. Jadamec

No. 405
LOS ANGELES HARBOR FIELD INVESTIGATION OF OIL AND BACKGROUND LUMINESCENCE SIGNATURES
Gross, H. G.

No. 406
IDENTIFICATION OF OIL COMPONENTS BY GAS CHROMATOGRAPHY FOLLOWED BY LOW TEMPERATURE LUMINESCENCE ANALYSIS
Brownrigg, J. T., and A. W. Nornig

No. 407
THE USE OF TOTAL LUMINESCENCE CONTOUR SPECTRA FOR OIL IDENTIFICATION
Hornig, A. W., and H. W. Elderling

No. 408
IDENTIFICATION OF OIL SAMPLES BY AN ELECTROLYTIC HYDROGEN EXTRACTION AND FLUORESCENCE METHOD
Schwarz, F. P., and S. T. Wasik

No. 409
SPECTROSCOPIC AND CHROMATOGRAPHIC TECHNIQUES USED IN PETROLEUM CHARACTERIZATION
McKay, J. F., and D. R. Latham

FFI contact Edwin S. Hodge, Administrative Assistant, 1976 Pittsburgh Conference, Carnegie-Mellon Institute of Research, 4400 Fifth Ave., Pittsburgh, Pennsylvania 15213

Mar. 9-11 International Conference on Oil Transport and Other Toxic Substances and Hazardous Substances on Lake Superior, Duluth, Minnesota, 1976.
Sponsored by Minnesota Pollution Control Agency; Upper Great Lakes Regional Commission; and the All University Council on Environmental Quality, University of Minnesota.

Oil Pollution Related Papers

Session 1 - An Assessment of the Effects of Transshipment of Hazardous Materials on Lake Superior

POTENTIAL DAMAGE FROM TOXIC MATERIALS IN LAKE SUPERIOR
Mount, D. I., N. J. Vick, and G. M. Christensen

This report reviews the present biological and physical condition of Lake Superior, including present levels of pollution and contamination by toxic and hazardous materials such as oil. The presentation also assesses the ecological damage and general environmental degradation caused by accidental spills, chronic discharges and normal transfer operations involving oil, other hydrocarbons and other toxic and hazardous substances. The report concludes that oil and petroleum products have less serious or lasting effects on the lake's environment than contamination by toxic chemicals; and it suggests several preventive measures, such as containerized shipping and limited seasonal shipping to minimize chemical pollution and contamination of the lake.

Session 3 - An Evaluation of Regulatory Measures for Reduction and Prevention of Chronic and Accidental Discharges of Hazardous Materials on Lake Superior

REGULATIONS OF TRANSPORTATION OF OIL AND OTHER HAZARDOUS SUBSTANCES
Tarlack, A. D.

The paper is primarily an overview of the laws, conventions, and jurisdictions on international, national, state and local levels which govern the waterborne transportation of hazardous materials such as oil. The author discusses the relative effectiveness as well as shortcomings of various statutes, safety measures and contingency plans in preventing or reducing intentional and accidental discharges of oil. The present allocation of regulatory jurisdiction between international bodies, federal government and states are identified, in order to aid states in devising the legal strategy to enact spill prevention and spill damage recovery legislation.

FFI contact Stephanie Lemenowsky, Minnesota Pollution Control Agency, 1035 West Country Rd. B-2, Roseville, Minnesota 55113

*Mar. 18-23 National Association of Recycling Industries, 63rd, San Francisco, California, 1976

FFI contact National Association of Recycling Industries, 330 Madison Ave., New York, New York 10017

Mar. 22-23 Industrial Pollution Control Measurement and Instrument Conference, New Jersey Institute of Technology, Newark, New Jersey, 1976.

Oil Pollution Related Papers

ANALYSIS OF LIGHT HYDROCARBONS
Shilman, A., and A. T. Ellgren

Analysis of light hydrocarbons (C_2-C_5 saturates and unsaturates) is performed with gas solid chromatography columns. Columns are prepared by first removing water from the column material (alumina) by heating (activation) and by then passing a carrier gas saturated with various alcohols or water through the column (deactivation).

LOW ALTITUDE SURVEILLANCE FOR WATER RESOURCES CONTROL
Fraga, G. W., and M. E. Holland

A one-year pilot project by the California State Resource Control Board examined the effectiveness of low altitude aerial surveillance. Results show the many ways in which this form of monitoring can support and improve water resources control programs. One of the significant values is that regular surveillance can detect turbidity and sedimentation, color, algae blooms, illegal oil discharges in receiving waters, and can identify points at which sampling should be conducted to check self-monitoring reports.

FFI contact I.P.C./M & I Conference Proceedings Division of Continuing Education, New Jersey Institute of Technology, 323 High St., Newark, New Jersey 07102

*Mar. 22-26 Advanced Water Pollution Control and Environmental Impact Physical and Chemical Waste Treatment, Austin, Texas, 1976.

FFI contact Engineering Institute, College of Engineering, Cockrell Hall 2102, University of Texas, Austin, Texas 78712

Mar. 28-30 National Petroleum Refiners Association Annual Meeting, San Antonio, Texas, 1976.

Oil Pollution Related Papers

FACTORS AFFECTING WASTE DISPOSAL ALTERNATIVES
VanIngen, R. E., and B. N. Bastian

ASSESSMENT OF INDUSTRIAL HAZARDOUS WASTE PRACTICES IN THE PETROLEUM REFINING INDUSTRY
Sanjour, W.

FFI contact National Petroleum Refiners Association,
1725 De Sales St. N.W., Washington, D.C. 20036

Mar. 30-April 1 "Resource Recovery" Industrial Pollution Conference and Exposition, 4th, Houston, Texas. 1976.
Sponsored by Water and Wastewater Equipment Manufacturers Association.

Oil Pollution Related Papers

MANAGING AN INLAND OIL SPILL
Elliot, P. R.

The difficulties encountered in clearing up an asphalt/kerosene spill in the Hackensack River are recounted. The polluter refused to pay the cleanup contractor because the spill was caused by vandals. The cleanup area was a swamp infested by snakes; and hunters were there illegally shooting red-winged black birds.

ORGANIZATION NECESSARY FOR MINIMIZING THE DAMAGING EFFECTS OF A MAJOR OIL SPILL
Alberts, D. A., Sr.

The lack of a realistic organizational guide to prepare personnel in charge of an oil handling facility can cause spill cleanup to be costly, inefficient and/or ineffective. A guide and a line diagram organizational chart are presented.

CASE STUDY: HANNAH BARGE SPILL, MILWAUKEE, WISCONSIN
Sullivan, E. L.

A major oil spill on Lake Michigan in the winter, its potential dangers and the positive corrective actions are described. Salvage and removal operations were quite successful due to the combined efforts of the discharger, contractors, and state and federal agencies. The contingency plan that was used was provided for by the Federal Water Pollution Control Act.

OIL SPILL REMOVAL/COMMERCIAL RESOURCES
Usher, D.

The development of commercial resources for oil spill cleanup since the "Torrey Canyon" disaster is reviewed.

There are now some 45 commercial spill cleanup resources in the U.S. The Oil Spill Control Association of America provides communication between industry, government and the scientific community. New methods, reduced costs and standardized hardware are the results of such communication.

FACTORS INFLUENCING OIL REMOVAL EFFICIENCY IN DISSOLVED AIR FLOTATION UNITS
Pearson, S. C.

The effect of oil, sulfide and pH on the chemicals used to treat refinery waste before flotation was studied using a laboratory dissolved air flotation unit. Oil content and pH had a minor effect compared to sulfide. Other wastes were tested for use as coagulents; activated sludge proved to aid in oil removal.

FFI contact Carl Novak, Water and Waste Water Equipment Manufacturers Association, 7900 Westpark Drive, Suite 304, McLean, Virginia 22101

*Apr. 4-6 International Petrochemical Conference, San Antonio, Texas, 1976.

FFI contact National Petroleum Refiners Association, Suite 802, 1725 DeSales St., N.W., Washington, D.C. 20036

Apr. 4-9 American Chemical Society Meeting, 171st, New York, N.Y., 1976.

Oil Pollution Related Papers

Symposium on a Biochemical Approach to Some Problems on Environmental Pollution

No. 7
AROMATIC HYDROCARBONS: DISTRIBUTION AND POSSIBLE FATE IN THE ENVIRONMENT
Gibson, D. T.

No. [illegible]
THE MICROBIAL METABOLISM OF HETEROCYCLIC AND ALICYCLIC COMPOUNDS
Patterson, C. D., and G. D. Hegeman

FFI contact American Chemical Society, 1155 16th St., N.W., Washington, D.C. 20036 (Abstracts of papers [illegible] Special Issue Sales)

*Apr. 5-8 National Water Resources and Ocean Engineering Convention and Exposition, San Diego, California, 1976.

FFI contact American Society of Civil Engineers,
345 E. 47th St., New York, New York 10017

*Apr. 21-23 Annual Symposium on Recent Advances in the Analytical Chemistry of Pollutants, 6th, Vienna, 1976.

FFI contact Dr. H. Malissa, Technische Hochschule Wien,
Getreidemarkt 9, A-1060 Wien, Austria

*Apr. 21-27 Group of Experts on the Scientific Aspects of Marine Pollution, 8th Session, Rome, Italy, 1976.

FFI contact World Meteorological Organization,
Avenue G Motta, 1211 Geneva, Switzerland

Apr. 25-28 Institute of Environmental Sciences Technical Meeting and Equipment Exposition, 22nd, Philadelphia, Pennsylvania, 1976.

Oil Pollution Related Papers

Session 5D: Water Pollution

AN ULTRASONIC OIL/WATER POLLUTION MONITOR
Houlihan, T. M., and F. E. McGrath

FFI contact B. L. Peterson, Institute of Environmental Sciences, 940 East Northwest Highway, Mt. Prospect, Illinois 60056

Apr. 25-28 National Conference on Control of Hazardous Material Spills, New Orleans, Louisiana, 1976.

Topics: Legislation, cleanup systems, international programs, contingency planning, prevention, government policies and programs, personnel safety, spill retrieval data systems, ultimate disposal, detection-monitoring-reporting, response capabilities, risk analysis, case histories, effects-impacts, spill monitoring, research and development.

Oil Pollution Related Papers

Session IIIA - Response

OIL AND HAZARDOUS MATERIALS CANNOT BE EFFECTIVELY REMOVED FROM LARGE BODIES OR WATERS OF BUSY RIVER SYSTEMS UNLESS ...
Whitebloom, S. W.

The problems encountered by the Metropolitan Sanitary District of Greater Chicago in attempting to clean up spills of oil and hazardous material are described. Federal agencies appear reluctant to direct moving traffic or declare "NO WAKE" areas in waterways during a cleanup operation.

Session IXB - Case Histories

CASE HISTORY: CLEANUP OF LITTLE MOUNTAIN SALVAGE YARD ACID SLUDGE AND OIL LAGOON
Rice, G. B., F. D. Nichols, H. J. Snyder, EPA, and J. Skujins

The Little Mountain Salvage Yard was used for disposal of waste from a waste oil processing center. The lagoon was declared a threat to U.S. waters. The case is discussed in terms of planning and coordination of the cleanup, disposal of the liquid contents of the lagoon and the legal problems.

FFI contact Gary Bennett, Department of Chemical Engineering, University of Toledo, Toledo, Ohio 43606

Apr. 29-30 (Las Vegas, Nevada) Environmental Law, 1976
May 18-19 (New York City, New York)

This is a practical course designed to provide current information on environmental law for those who wish to grow professionally through continuing education.

Oil Pollution Related Lectures

NATIONAL ENVIRONMENTAL POLICY ACT
Dunkelberger, H. E., Jr

The evolution of NEPA, environmental impact statements trends in judicial review, CEQ guidelines and possible amendments are discussed.

HAZARDOUS MATERIALS, PESTICIDES AND TOXIC SUBSTANCES
Miller, M. L.

Federal legislation, implementation of regulations and enforcement procedures in this area are analyzed.

WATER POLLUTION CONTROL
Arbuckle, J. G.

A historical review of U.S. water pollution control laws is given. Regulations implementing the 1972 Act, user charges, court decisions, state and local activities and future possible amendments are topics of discussion.

FFI contact N. C. McNerney, Government Institutes, Inc., 4733 Bethesda Ave., N.W., Washington, D.C. 20014

May 3-6 Offshore Technology Conference, 8th, Houston, Texas, 1976. Sponsored jointly by AIChE, AIME, AAPG, ASCE, ASME, MTS, IEEE, SEG and SNAME.

Oil Pollution Related Papers

OTC 2444
OCCURRENCES OF OIL AND GAS SEEPS ALONG THE GULF OF ALASKA
Blasko, D. P.

OTC 2445
RESULTS OF AN ENVIRONMENTAL RESEARCH PROGRAM IN THE CANADIAN BEAUFORT SEA
Hnatiuk, J.

OTC 2446
ENVIRONMENTAL CONSIDERATIONS IN THE DESIGN OF BALLAST WATER OUTFALLS
Johnston, C. S., and A. R. Halliwell

OTC 2447
ENVIRONMENTAL ASPECTS OF PRODUCED WATERS FROM OIL AND GAS EXTRACTION OPERATIONS IN OFFSHORE AND COASTAL WATERS
Weiss, F. T., C. D. McAuliffe, and C. B. Koons

OTC 2448
NONVOLATILE HYDROCARBONS ALONG TANKER ROUTES OF THE PACIFIC OCEAN
Brown, R. A., and T. D. Searl

OTC 2449
FATE AND EFFECTS OF OIL ON MARINE LIFE: PROGRESS REPORT ON RESEARCH SPONSORED BY THE PETROLEUM INDUSTRY
Lasday, A. H., and E. W. Mertens

OTC 2450
RISK ANALYSIS AND OIL SPILL EXPECTATION FOR DEEPWATER PORTS
Moser, W. A., M. P. Noel, and J. M. Heckard

OTC 2454
LABORATORY BIOLOGICAL STUDIES: MAKING THEM APPROPRIATE FOR PREDICTING THE EFFECTS OF OFFSHORE OIL AND GAS OPERATIONS
Hester, F. J.

OTC 2691
SYSTEM MODEL DEVELOPMENT OF TWO FAST-CURRENT OIL REMOVAL SYSTEMS
Ard, R. W., D. S. Jensen, R. Ayers, and R. Beach

OTC 2692
MEANS OF MINIMIZING POLLUTION AT CONVENTIONAL PIER AND SEA ISLAND FACILITIES
Fetters, C. H., Jr.

OTC 2693
A FERROMAGNETIC SORBENT SYSTEM FOR OIL SPILL RECOVERY
Turbeville, J. E.

OTC 2694
THE ANALYSIS OF A CONTAINED EMULSIFIED OIL SLICK
Collins, D. J., G. D. M. MacKay, and K. T. Wong

OTC 2695
TEST OF OIL RECOVERY DEVICES IN A BROKEN ICE FIELD
Getman, J. H., L. A. Schultz, and P. C. Deslauriers

OTC 2696
PERFORMANCE TESTS OF OFF THE SHELF OIL SKIMMERS
Griffiths, R.

OTC 2697
HIGH SEAS OIL SPILL CONTROL PROGRAM OF THE SUPERVISOR OF SALVAGE
Sea, R.

OTC 2698
COTTON - THE NATURAL SORBENT FOR COMBATTING OIL POLLUTION
Meenaghan, G. F., J. E. Halligan, A. A. Ball, and J. F. Leary

OTC 2714
EVALUATING OIL SPILL RISK EXPOSURE FROM DEEPWATER PORTS
Brown, D. W.

OTC 2715
ANALYSIS OF RELATIVE POLLUTION RISK AND ECONOMICS OF SHIP VERSUS PIPELINE TRANSPORT OF OCS OIL TO ONSHORE TERMINALS
Donovan, L. J., J. Mulhern, and S. C. Fischer

FFI contact Ms. Sherry Anderson, Public Relations Manager, Offshore Technology Conference, 6200 North Central Expressway, Dallas, Texas 75206

*May 4-6 Purdue Industrial Waste Conference, 31st, Purdue University, West Lafayette, Indiana, 1976.

FFI contact Dr. A. J. Steffen, Civil Engineering Bldg., Purdue University, West Lafayette, Indiana 47907

May 16-22 International Petroleum Exposition, 53rd, Tulsa, Oklahoma, 1976.

The first non-commercial "World Energy Science Panorama" has a series of exhibits on energy, ecology and the earth sciences. Working models, graphic illustrations, movies and slides are included. The Energy Science Panorama contains various exhibits on new and innovative technology for electricity, coal, petroleum and gas, shale oil, nuclear, solar and wind energy, waste regeneration and hydrogen. There are exhibits on miscellaneous forms of energy and how they affect the environment and offshore-production techniques. An "Energy Film Festival," under the auspices of the Oklahoma Petroleum Council, will feature films relating to protection of the environment and ecology, while carrying out oil, gas and other energy source operations.

FFI contact Mr. William Sterne, Assistant Publicity Director, Publicity Office, 2126 East 15th, Tulsa, Oklahoma 74104

*May 24-28 Offshore Wales Exhibition and Conference, Cardiff, Wales, U.K., 1976.

FFI contact Cardiff City Council, Cardiff, Wales, United Kingdom.

June 20-26 ACHEMA '76, Frankfurt (Main), Federal Republic of Germany.
Cosponsored by: European Federation of Corrosion and European Federation of Chemical Engineers.

The congress will include a full program of scientific and technical papers, including many phases of pollution control.

Oil Pollution Related Papers

Waste gases, waste water, refuse and recycling, noise

UNTERSUCHUNGEN ZUR WIRTSCHAFTLICHEN UND SCHADLOSEN BESEITIGUNG VON ALTEMULSIONEN UND ÖLHALTIGEN SPÜLWÄSSERN ZWEIER KALTWALZWERKE. (INVESTIGATIONS BEARING ON THE ECONOMICAL AND SAFE DISPOSAL OF SPENT EMULSIONS AND OILY WASH WATERS FROM TWO COLD ROLLING MILLS)
Steinbach, G., H. Kroener, and W. Meininghaus

FFI contact National Chemical Exposition, 86 Randolph St., Chicago, Illinois 60601

*June 27-30 The Third National Conference on Complete WateReuse: Symbiosis as a Means of Abatement for Multi-Media Pollution, Cincinnati, Ohio, 1976.

Sponsored by Environmental Division AIChE, and Environmental Protection Agency.

FFI contact Mr. L. K. Cecil, Meeting Chairman,
418 Lincoln Bldg., Champaign, Illinois 61820

*end June-
early July

Subgroup of the Joint Group of Experts on IGOSS Marine Pollution Monitoring Pilot Project, Monaco, 1976. Sponsored by International Oceanographic Commission and World Meteorological Organization.

FFI contact International Oceanographic Commission,
Place de Fontenoy, 75700 Paris, France

Jun. 28-
Jul. 1

The World Congress on Chemical Engineering: Chemical Engineering in a Changing World, International Congress Centre RAI, Amsterdam, The Netherlands, 1976. Sponsored by American Institute of Chemical Engineers.

Oil Pollution Related Papers

Session B3: Loss Prevention

DEVELOPMENT IN THE TRANSPORT AND STORAGE OF HAZARDOUS SUBSTANCES
Buschmann, C. H.

RESEARCH IN LOSS PREVENTION
Juschek, H. I.

EFFECTIVE SOFTWARE IN LOSS PREVENTION (E.G. PROCEDURES, TRAINING AND ORGANIZATION)
Kolodner, H. J.

Session A5: Environment and Human Activities

ADVANCED TREATMENT OF INDUSTRIAL WASTE WATERS
Eckenfelder, W. W.

Session A7: Frontiers of Chemical Engineering

SYSTEMS STUDY OF THE PETROCHEMICAL INDUSTRY
Stadtherr, M. A., and D. F. Rudd

FFI contact AIChE Coordinator Ted Weaver, Fluor Corporation,
East Los Angeles Branch, Box 7030, Los Angeles, California 90022

Jun. 28- Jul. 2 Gordon Research Conferences, Environmental Sciences: Water, Proctor Academy, Andover, New Hampshire, 1976.

Oil Pollution Related Topics

Organic Materials in Water

SOURCES OF ORGANIC MATERIALS IN WATER
Jolley, R. L., Discussion leader

ANTHROPOGENIC SOURCES OF ORGANIC POLLUTANTS IN WATER
Keith, L.

STABILITY AND DEGRADATION OF ORGANIC MATERIALS IN NATURAL WATERS
Morgan, J. L., Discussion leader

MICROBIAL DEGRADATION OF ORGANIC COMPOUNDS
Dagley, S.

SEPARATION/ISOLATION OF ORGANIC MATERIALS IN WATER
Minear, R. A., Discussion leader

IDENTIFICATION OF ORGANIC CONTAMINANTS OF GC/MS
Hites, R. A.

SURVEILLANCE OF MARINE ENVIRONMENTS FOR HYDROCARBONS
McAuliffe, C.

RECENT DEVELOPMENTS IN TREATMENT OF WATER AND WASTEWATER FOR ORGANIC REMOVAL
Weber, W. J., Jr., Discussion leader

*Jul. 12-15 Annual Intersociety Conference on Environmental Systems, 6th, San Diego, California
Sponsored by AIChE, AIAA, SAE, ASME and Aerospace Medical Association.

Oil Pollution Related Topics

Marine Technology Applications

DEVELOPMENT OF DESIGN CRITERIA FOR VACCUM WASTEWATER TRANSFER SYSTEMS
Saillman, E. P.

OPERATIONAL EXPERIENCE WITH A VACCUM COLLECTION AND WASTE INCINERATION SYSTEM ABOARD A U.S. COAST GUARD CUTTER
White, J. A.

BILGE WATER TREATMENT WITH A TUBULAR ULTRAFILTRATION SYSTEM
Harris, L. R., D. F. Jackson, and P. Schatzberg

FFI contact P. Schatzberg, Naval Ship R & D Center, Code 2861, Annapolis, Maryland 21402

Sep. 13-15 Oceans '76, Washington, D.C., 1976. Sponsored by Marine Technical Society.

Many topics to be discussed will include water quality/pollution; remote sensing from satellite and aircraft.

FFI contact Executive Director, Marine Technology Society, 1730 M St., N.W., Washington, D.C. 20036

Sep. 14-18 Aquatech '76 Exposition and Conference, Amsterdam, The Netherlands, 1976

Aquatech '76 is one of the world's largest water equipment exhibitions and will include products and information on water purification and water pollution control equipment and technology.

FFI contact Mr. George Ruffner, U.S. Department of Commerce OIM/BIC, Room 1015, Washington, D.C. 20230

Sep. 21-24 Offshore North Sea Conference and Exhibition (ONS '76), 2nd, Stavanger, Norway.

FFI contact Exhibition Office, Rogaland Trade Fair Ltd., Siddishallen, P.O. Box 410, 4001 Stavanger, Norway

Sep. 21-25 IOPEC International Oil Pollution Exhibition and Conference on Systems of Prevention of Oil Pollution at Sea and in Coastal and Inland Waters, Hamburg Federal Republic of Germany, 1976.

IOPEC Exhibition will be held in conjunction with the International Ship, Machinery and Marine Technology Exhibition and Congress. The exhibition will focus on systems of prevention of oil and chemical pollution at sea and in coastal and inland waters. There will be products and information on the following subjects: research and development; consultation, especially for land spills; absorbents, including absorbent booms; chemical dispersants; oil booms; spray systems; tank cleaning agents and equipment; vacuum trucks; special purpose trailers for booms and accessory equipment; skimmers ranging from small, portable units to large size units; special purpose craft, various types of pumps; oil-water separators; effluent monitors; spill detection and monitoring devices; training courses; and engineering support and services.

The IOPEC Conference (Sep. 24, 1976) will analyze and discuss: (1) disasters in the open ocean such as collision at sea, oil rig and pipeline leaks (control would be primarily by spray techniques); and (2) control of coastal and inland waterways disasters by spray, boom and mechanical collection devices.

FFI contact IOPEC, Ms. Dorothy Mills, P.O. Box 428, South Norwalk, Connecticut 06856

Oct. 3-8 Water Pollution Control Federation Conference, 49th, Minneapolis, Minnesota, 1976.

Topics to be covered include marine pollution and hazards, prevention and cleanup, large tankers and potential oil spills, and arctic transport of oil.

FFI contact Robert Canham, WPCF Executive Secretary, 3900 Wisconsin Ave., Washington, D.C. 20016

Oct. 17-22 International Conference on Water Pollution Research, 8th, Sydney, Australia, 1976.

Range of topics to be discussed include estuarine pollution surveys, pollution from oil and offshore materials resources development, and industrial wastes and petrochemicals. Workshop session will review progress and discuss current problems in water resource quality management, marine and estuarine waste disposal aspects, ultimate disposal of solid and liquid wastes, and land surface and subsurface disposal of waste water.

FFI contact Dr. S. H. Jenkins, Chairman, Programme Committee of the IAWPR, Headington Hill Hall, Oxford, OX3 OBW, England

Oct. 26-30 Antipollution '76, Milan, Italy, 1976.

FFI contact Presidence, [illegible] Via Boccaccio 7, 20123 Milan, Italy

Nov. 2-4 Fate and Effects of Petroleum Hydrocarbons in Marine Ecosystems and Organisms, Seattle, Washington, 1976. Cosponsored by the National Oceanic and Atmospheric Administration, Outer Continental Shelf Environmental Assessment Program and the Environmental Protection Agency.

The Symposium is concerned with the biological interactions of petroleum in the marine environment, with special emphasis on the distribution and effects of petroleum hydrocarbons on cold-water marine ecosystems of arctic and subarctic latitudes.

FFI contact D. A. Wolfe, Symposium Coordinator, NOAA, OCS Environmental Assessment Program, Rx4, Boulder, Colorado 80302

SUBJECT INDEX

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C-0782-76 BIOL EFFECTS OIL POLLUT, CLEANUP AND RECOVERY,
C-0969-76 BIOL EFFECTS OIL POLLUT, DESIGN AND ENGIN,
C-1039-76 BIOL EFFECTS OIL POLLUT, DESIGN AND ENGIN,
C-0985-76 BIOL EFFECTS OIL POLLUT, ECON EFFECTS OIL POLLUT,
C-0999-76 BIOL EFFECTS OIL POLLUT, ECON EFFECTS OIL POLLUT,
C-1009-76 BIOL EFFECTS OIL POLLUT, ECON EFFECTS OIL POLLUT,
C-1052-76 BIOL EFFECTS OIL POLLUT, GEN EFFECTS OIL POLLUT, ECON EFFECTS OIL POLLUT, REPORTING, SOCIAL EFFECTS OIL POLLUT,
C-1049-76 BIOL EFFECTS OIL POLLUT, GEN EFFECTS OIL POLLUT, GEN EFFECTS OIL PROSPCT/PROD

C-1059-76 BIOL EFFECTS OIL POLLUT, GEN EFFECTS OIL POLLUT, GEN FATE OF OIL IN THE ENVIRON
C-1064-76 BIOL EFFECTS OIL POLLUT, GEN EFFECTS OIL POLLUT, GEN FATE OF OIL IN THE ENVIRON,
C-1093-76 BIOL EFFECTS OIL POLLUT, GEN EFFECTS OIL PROSPCT/PROD,
C-1154-76 BIOL EFFECTS OIL POLLUT, GEN EFFECTS OIL PROSPCT/PROD, CHEM EFFECTS OIL POLLUT, STATE LEG,
C-1098-76 BIOL EFFECTS OIL POLLUT, GEN EFFECTS OIL PROSPCT/PROD, PHYS EFFECTS OIL POLLUT,
C-1090-76 BIOL EFFECTS OIL POLLUT, GEN EFFECTS OIL PROSPCT/PROD, CLEANUP AND RECOVERY,
C-0975-76 BIOL EFFECTS OIL POLLUT, GEN FATE OF OIL IN THE ENVIRON
C-0970-76 BIOL EFFECTS OIL POLLUT, GEN FATE OF OIL IN THE ENVIRON, ANALYSIS,
C-0991-76 BIOL EFFECTS OIL POLLUT, GEN FATE OF OIL IN THE ENVIRON, PHYS CHANGES OF OIL IN THE ENVIRON,
C-0072-76* BIOL EFFECTS OIL POLLUT, MONITORING,
C-0650-76 BIOL EFFECTS OIL POLLUT, MONITORING, ANALYSIS,
C-0054-76* BIOL EFFECTS OIL POLLUT, *MONITORING,
C-0667-76 BIOL EFFECTS OIL POLLUT, MONITORING,
C-0996-76 BIOL EFFECTS OIL POLLUT, PHYS CHANGE OF OIL IN THE ENVIRON
C-1008-76 BIOL EFFECTS OIL POLLUT, REPORTING,
C-0647-76 BIOL EFFECTS OIL POLLUT, REPORTING,
C-0644-76 BIOL EFFECTS OIL POLLUT, REPORTING, CLEANUP AND RECOVERY
C-0636-76 BIOL EFFECTS OIL POLLUT, REPORTING, MONITORING, TRANSFER AND TRANSPORT
C-0980-76 BIOL EFFECTS OIL POLLUT, RESTORATION,
C-0803-76 BIOL EFFECTS OIL POLLUT, RESTORATION,
C-0805-76 BIOL EFFECTS OIL POLLUT, RESTORATION,
C-0977-76 BIOL EFFECTS OIL POLLUT, WASTE TREATMENT/DISPOSAL METHODS
C-0841-76 BIOL EFFECTS OIL POLLUT, WASTE TREATMENT/DISPOSAL METHODS, ANALYSIS, SAMPLING,

C-1070-76. BIOL EFFECTS OIL PROSPCT/PROD,
C-1071-76 BIOL EFFECTS OIL PROSPCT/PROD,
C-1233-76 BIOL EFFECTS OIL PROSPCT/PROD, BIBLIOGRAPHIES,
C-0976-76 BIOL EFFECTS OIL PROSPCT/PROD, BIOL EFFECTS OIL POLLUT,
C-1013-76 BIOL EFFECTS OIL PROSPCT/PROD, BIOL EFFECTS OIL POLLUT,
C-1091-76 BIOL EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT/PROD,
C-1110-76 BIOL EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT/PROD,
C-1116-76 BIOL EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT/PROD,
C-1136-76 BIOL EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT/PROD,
C-1152-76 BIOL EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT

	/PROD,
C-1153-76	BIOL EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT /PROD,
C-1107-76	BIOL EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT /PROD, ECON EFFECTS OIL PROSPCT/PROD
C-1104-76	BIOL EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT /PROD, ECON EFFECTS OIL PROSPCT/PROD
C-1132-76	BIOL EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT /PROD, ECON EFFECTS OIL PROSPCT/PROD,
C-1041-76	CHEM EFFECTS OIL POLLUT,
C-1042-76	CHEM EFFECTS OIL POLLUT, BIOL DEGRADATION, CLEANUP AND RECOVERY
C-1154-76	CHEM EFFECTS OIL POLLUT, GEN EFFECTS OIL PROSPCT/PROD, BIOL EFFECTS OIL POLLUT, STATE LEG,
C-0740-76	CLEANUP AND RECOVERY,
C-0746-76	CLEANUP AND RECOVERY,
C-0752-76	CLEANUP AND RECOVERY,
C-0756-76	CLEANUP AND RECOVERY,
C-0761-76	CLEANUP AND RECOVERY,
C-0763-76	CLEANUP AND RECOVERY,
C-0764-76	CLEANUP AND RECOVERY,
C-0765-76	CLEANUP AND RECOVERY,
C-0769-76	CLEANUP AND RECOVERY,
C-0777-76	CLEANUP AND RECOVERY,
C-0778-76	CLEANUP AND RECOVERY,
C-0779-76	CLEANUP AND RECOVERY,
C-0781-76	CLEANUP AND RECOVERY,
C-0785-76	CLEANUP AND RECOVERY,
C-0787-76	CLEANUP AND RECOVERY,
C-0789-76	CLEANUP AND RECOVERY,
C-0790-76	CLEANUP AND RECOVERY,
C-0791-76	CLEANUP AND RECOVERY,
C-0792-76	CLEANUP AND RECOVERY,
C-0797-76	CLEANUP AND RECOVERY,
C-0799-76	CLEANUP AND RECOVERY,
C-0801-76	CLEANUP AND RECOVERY,
C-1234-76	CLEANUP AND RECOVERY, BIBLIOGRAPHIES, ANALYSIS, BIOL EFFECTS OIL POLLUT, REPORTING,
C-1158-76	CLEANUP AND RECOVERY, BIOL DEGRADATION,
C-1166-76	CLEANUP AND RECOVERY, BIOL DEGRADATION,
C-1168-76	CLEANUP AND RECOVERY, BIOL DEGRADATION,
C-1170-76	CLEANUP AND RECOVERY, BIOL DEGRADATION,
C-1161-76	CLEANUP AND RECOVERY, BIOL DEGRADATION, WASTE TREATMENT/DISPOSAL METHODS
C-0782-76	CLEANUP AND RECOVERY, BIOL EFFECTS OIL POLLUT,
C-0972-76	CLEANUP AND RECOVERY, BIOL EFFECTS OIL POLLUT,
C-0989-76	CLEANUP AND RECOVERY, BIOL EFFECTS OIL POLLUT,
C-1002-76	CLEANUP AND RECOVERY, BIOL EFFECTS OIL POLLUT,
C-1007-76	CLEANUP AND RECOVERY, BIOL EFFECTS OIL POLLUT,

C-1034-76	CLEANUP AND RECOVERY, BIOL EFFECTS OIL POLLUT,
C-1042-76	CLEANUP AND RECOVERY, CHEM EFFECTS OIL POLLUT, BIOL DEGRADATION,
C-0744-76	CLEANUP AND RECOVERY, CONTAINMENT,
C-0757-76	CLEANUP AND RECOVERY, CONTAINMENT, CONTINGENCY PLANNING, PERSONNEL TRAINING/EDUCATION,
C-0768-76	CLEANUP AND RECOVERY, CONTAINMENT, CONTINGENCY PLANNING, RECLAMATION AND REUSE
C-0743-76	CLEANUP AND RECOVERY, CONTAINMENT, DESIGN AND ENGIN,
C-0753-76	CLEANUP AND RECOVERY, CONTAINMENT, DESIGN AND ENGIN,
C-0729-76	CLEANUP AND RECOVERY, CONTAINMENT, DESIGN AND ENGIN,
C-0750-76	CLEANUP AND RECOVERY, CONTAINMENT, TRANSFER AND TRANSPORT
C-0963-76	CLEANUP AND RECOVERY, CONTINGENCY PLANNING,
C-0965-76	CLEANUP AND RECOVERY, CONTINGENCY PLANNING,
C-0961-76	CLEANUP AND RECOVERY, CONTINGENCY PLANNING, CONTAINMENT
C-0742-76	CLEANUP AND RECOVERY, DESIGN AND ENGIN,
C-0745-76	CLEANUP AND RECOVERY, DESIGN AND ENGIN,
C-0748-76	CLEANUP AND RECOVERY, DESIGN AND ENGIN,
C-0749-76	CLEANUP AND RECOVERY, DESIGN AND ENGIN,
C-0755-76	CLEANUP AND RECOVERY, DESIGN AND ENGIN,
C-0758-76	CLEANUP AND RECOVERY, DESIGN AND ENGIN,
C-0759-76	CLEANUP AND RECOVERY, DESIGN AND ENGIN,
C-0760-76	CLEANUP AND RECOVERY, DESIGN AND ENGIN,
C-0766-76	CLEANUP AND RECOVERY, DESIGN AND ENGIN,
C-0767-76	CLEANUP AND RECOVERY, DESIGN AND ENGIN,
C-0771-76	CLEANUP AND RECOVERY, DESIGN AND ENGIN,
C-0772-76	CLEANUP AND RECOVERY, DESIGN AND ENGIN,
C-0773-76	CLEANUP AND RECOVERY, DESIGN AND ENGIN,
C-0774-76	CLEANUP AND RECOVERY, DESIGN AND ENGIN,
C-0775-76	CLEANUP AND RECOVERY, DESIGN AND ENGIN,
C-0776-76	CLEANUP AND RECOVERY, DESIGN AND ENGIN,
C-0780-76	CLEANUP AND RECOVERY, DESIGN AND ENGIN,
C-0786-76	CLEANUP AND RECOVERY, DESIGN AND ENGIN,
C-0784-76	CLEANUP AND RECOVERY, DESIGN AND ENGIN,
C-0793-76	CLEANUP AND RECOVERY, DESIGN AND ENGIN,
C-0795-76	CLEANUP AND RECOVERY, DESIGN AND ENGIN,
C-0796-76	CLEANUP AND RECOVERY, DESIGN AND ENGIN,
C-0798-76	CLEANUP AND RECOVERY, DESIGN AND ENGIN,
C-0802-76	CLEANUP AND RECOVERY, DESIGN AND ENGIN,
C-0754-76	CLEANUP AND RECOVERY, DESIGN AND ENGIN, CONTAINMENT,
C-0800-76	CLEANUP AND RECOVERY, ECON EFFECTS OIL POLLUT, CONTINGENCY PLANNING, REPORTING,
C-1045-76	CLEANUP AND RECOVERY, ECON EFFECTS OIL POLLUT, FOREIGN LEG, GEN EFFECTS OIL POLLUT,
C-1067-76	CLEANUP AND RECOVERY, GEN EFFECTS OIL POLLUT,
C-1122-76	CLEANUP AND RECOVERY, GEN EFFECTS OIL PROSPCT/PROD,
C-1137-76	CLEANUP AND RECOVERY, GEN EFFECTS OIL PROSPCT/PROD,
C-1090-76	CLEANUP AND RECOVERY, GEN EFFECTS OIL PROSPCT/PROD, BIOL EFFECTS OIL POLLUT,

C-1126-76	CLEANUP AND RECOVERY, GEN EFFECTS OIL PROSPCT/PROD, GEN FATE OF OIL IN THE ENVIRON, CONTINGENCY PLANNING,
C-1187-76	CLEANUP AND RECOVERY, GEN FATE OF OIL IN THE ENVIRON, SOURCE IDENTIFICATION,
C-0082-76*	CLEANUP AND RECOVERY, *MONITORING, SAMPLING,
C-0959-76	CLEANUP AND RECOVERY, PERSONNEL TRAINING/EDUCATION,
C-0644-76	CLEANUP AND RECOVERY, REPORTING, BIOL EFFECTS OIL POLLUT,
C-0637-76	CLEANUP AND RECOVERY, REPORTING,
C-0794-76	CLEANUP AND RECOVERY, RESTORATION, CONTINGENCY PLANNING
C-0694-76	CLEANUP AND RECOVERY, SAMPLING,
C-1075-76	CLEANUP AND RECOVERY, SOCIAL EFFECTS OIL PROSPCT/PROD, CONTINGENCY PLANNING,
C-0788-76	CLEANUP AND RECOVERY, TRANSFER AND TRANSPORT,
C-0824-76	CLEANUP AND RECOVERY, TRANSFER AND TRANSPORT,
C-1209-76	CLEANUP AND RECOVERY, U.S. LEG, MONITORING,
C-0741-76	CLEANUP AND RECOVERY, WASTE TREATMENT/DISPOSAL METHODS,
C-0747-76	CLEANUP AND RECOVERY, WASTE TREATMENT/DISPOSAL METHODS,
C-0751-76	CLEANUP AND RECOVERY, WASTE TREATMENT/DISPOSAL METHODS,
C-0762-76	CLEANUP AND RECOVERY, WASTE TREATMENT/DISPOSAL METHODS,
C-0770-76	CLEANUP AND RECOVERY, WASTE TREATMENT/DISPOSAL METHODS,
C-0783-76	CLEANUP AND RECOVERY, WASTE TREATMENT/DISPOSAL METHODS,
C-0847-76	CLEANUP AND RECOVERY, WASTE TREATMENT/DISPOSAL METHODS,
C-0896-76	CLEANUP AND RECOVERY, WASTE TREATMENT/DISPOSAL METHODS,
C-0903-76	CLEANUP AND RECOVERY, WASTE TREATMENT/DISPOSAL METHODS,
C-0913-76	CLEANUP AND RECOVERY, WASTE TREATMENT/DISPOSAL METHODS,
C-0922-76	CLEANUP AND RECOVERY, WASTE TREATMENT/DISPOSAL METHODS,
C-0868-76	CLEANUP AND RECOVERY, WASTE TREATMENT/DISPOSAL METHODS, BIOL DEGRADATION,
C-0837-76	CLEANUP AND RECOVERY, WASTE TREATMENT/DISPOSAL METHODS, CONTINGENCY PLANNING,
C-0731-76	CONTAINMENT,
C-0738-76	CONTAINMENT,
C-0744-76	CONTAINMENT, CLEANUP AND RECOVERY,
C-0757-76	CONTAINMENT, CLEANUP AND RECOVERY, CONTINGENCY PLANNING, PERSONNEL TRAINING/EDUCATION,
C-0766-76	CONTAINMENT, CLEANUP AND RECOVERY, CONTINGENCY PLANNING, RECLAMATION AND REUSE
C-0743-76	CONTAINMENT, CLEANUP AND RECOVERY, DESIGN AND ENGIN,
C-0753-76	CONTAINMENT, CLEANUP AND RECOVERY, DESIGN AND ENGIN,
C-0750-76	CONTAINMENT, CLEANUP AND RECOVERY, TRANSFER AND TRANSPORT
C-0754-76	CONTAINMENT, CLEANUP AND RECOVERY, DESIGN AND ENGIN,
C-0729-76	CONTAINMENT, CLEANUP AND RECOVERY, DESIGN AND ENGIN,
C-0961-76	CONTAINMENT, CONTINGENCY PLANNING, CLEANUP AND RECOVERY,
C-0728-76	CONTAINMENT, DESIGN AND ENGIN,
C-0730-76	CONTAINMENT, DESIGN AND ENGIN,
C-0732-76	CONTAINMENT, DESIGN AND ENGIN,

C-0733-76	CONTAINMENT, DESIGN AND ENGIN,
C-0734-76	CONTAINMENT, DESIGN AND ENGIN,
C-0735-76	CONTAINMENT, DESIGN AND ENGIN,
C-0736-76	CONTAINMENT, DESIGN AND ENGIN,
C-0737-76	CONTAINMENT, DESIGN AND ENGIN,
C-0739-76	CONTAINMENT, DESIGN AND ENGIN,
C-0812-76	CONTAINMENT, TRANSFER AND TRANSPORT, U.S. LEG, WASTE TREATMENT/DISPOSAL METHODS
C-1200-76	CONTAINMENT, U.S. LEG, TRANSFER AND TRANSPORT, WASTE TREATMENT/DISPOSAL METHODS,
C-0931-76	CONTAINMENT, WASTE TREATMENT/DISPOSAL METHODS, DESIGN AND ENGIN
C-0757-76	CONTINGENCY PLANNING, CLEANUP AND RECOVERY, CONTAINMENT, PERSONNEL TRAINING/EDUCATION,
C-0768-76	CONTINGENCY PLANNING, CLEANUP AND RECOVERY, CONTAINMENT, RECLAMATION AND REUSE
C-0800-76	CONTINGENCY PLANNING, CLEANUP AND RECOVERY, ECON EFFECTS OIL POLLUT, REPORTING,
C-0794-76	CONTINGENCY PLANNING, CLEANUP AND RECOVERY, RESTORATION,
C-0963-76	CONTINGENCY PLANNING, CLEANUP AND RECOVERY,
C-0965-76	CONTINGENCY PLANNING, CLEANUP AND RECOVERY,
C-0961-76	CONTINGENCY PLANNING, CLEANUP AND RECOVERY, CONTAINMENT
C-1221-76	CONTINGENCY PLANNING, FOREIGN LEG, GEN EFFECTS OIL POLLUT,
C-1054-76	CONTINGENCY PLANNING, GEN EFFECTS OIL POLLUT, GEN FATE OF OIL IN THE ENVIRON, PERSONNEL TRAINING/EDUCATION
C-1131-76	CONTINGENCY PLANNING, GEN EFFECTS OIL PROSPCT/PROD, DESIGN AND ENGIN, MONITORING,
C-1143-76	CONTINGENCY PLANNING, GEN EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL POLLUT,
C-1126-76	CONTINGENCY PLANNING, GEN EFFECTS OIL PROSPCT/PROD, GEN FATE OF OIL IN THE ENVIRON, CLEANUP AND RECOVERY,
C-0964-76	CONTINGENCY PLANNING, PERSONNEL TRAINING/EDUCATION,
C-0960-76	CONTINGENCY PLANNING, PERSONNEL TRAINING/EDUCATION,
C-0692-76	CONTINGENCY PLANNING, REMOTE SENSING, REPORTING,
C-1075-76	CONTINGENCY PLANNING, SOCIAL EFFECTS OIL PROSPCT/PROD, CLEANUP AND RECOVERY,
C-0962-76	CONTINGENCY PLANNING, U.S. LEG,
C-1210-76	CONTINGENCY PLANNING, U.S. LEG,
C-0837-76	CONTINGENCY PLANNING, WASTE TREATMENT/DISPOSAL METHODS, CLEANUP AND RECOVERY,
C-0829-76	DESIGN AND ENGIN,
C-0969-76	DESIGN AND ENGIN, BIOL EFFECTS OIL POLLUT,
C-1039-76	DESIGN AND ENGIN, BIOL EFFECTS OIL POLLUT,
C-0742-76	DESIGN AND ENGIN, CLEANUP AND RECOVERY,
C-0745-76	DESIGN AND ENGIN, CLEANUP AND RECOVERY,
C-0748-76	DESIGN AND ENGIN, CLEANUP AND RECOVERY,

C-0749-76	DESIGN AND ENGIN, CLEANUP AND RECOVERY,
C-0755-76	DESIGN AND ENGIN, CLEANUP AND RECOVERY,
C-0758-76	DESIGN AND ENGIN, CLEANUP AND RECOVERY,
C-0759-76	DESIGN AND ENGIN, CLEANUP AND RECOVERY,
C-0760-76	DESIGN AND ENGIN, CLEANUP AND RECOVERY,
C-0766-76	DESIGN AND ENGIN, CLEANUP AND RECOVERY,
C-0767-76	DESIGN AND ENGIN, CLEANUP AND RECOVERY,
C-0771-76	DESIGN AND ENGIN, CLEANUP AND RECOVERY,
C-0772-76	DESIGN AND ENGIN, CLEANUP AND RECOVERY,
C-0773-76	DESIGN AND ENGIN, CLEANUP AND RECOVERY,
C-0774-76	DESIGN AND ENGIN, CLEANUP AND RECOVERY,
C-0775-76	DESIGN AND ENGIN, CLEANUP AND RECOVERY,
C-0776-76	DESIGN AND ENGIN, CLEANUP AND RECOVERY,
C-0780-76	DESIGN AND ENGIN, CLEANUP AND RECOVERY,
C-0782-76	DESIGN AND ENGIN, CLEANUP AND RECOVERY,
C-0784-76	DESIGN AND ENGIN, CLEANUP AND RECOVERY,
C-0793-76	DESIGN AND ENGIN, CLEANUP AND RECOVERY,
C-0795-76	DESIGN AND ENGIN, CLEANUP AND RECOVERY,
C-0796-76	DESIGN AND ENGIN, CLEANUP AND RECOVERY,
C-0798-76	DESIGN AND ENGIN, CLEANUP AND RECOVERY,
C-0802-76	DESIGN AND ENGIN, CLEANUP AND RECOVERY,
C-0743-76	DESIGN AND ENGIN, CLEANUP AND RECOVERY, CONTAINMENT,
C-0753-76	DESIGN AND ENGIN, CLEANUP AND RECOVERY, CONTAINMENT,
C-0754-76	DESIGN AND ENGIN, CLEANUP AND RECOVERY, CONTAINMENT,
C-0729-76	DESIGN AND ENGIN, CONTAINMENT, CLEANUP AND RECOVERY,
C-0728-76	DESIGN AND ENGIN, CONTAINMENT,
C-0730-76	DESIGN AND ENGIN, CONTAINMENT,
C-0732-76	DESIGN AND ENGIN, CONTAINMENT,
C-0733-76	DESIGN AND ENGIN, CONTAINMENT,
C-0734-76	DESIGN AND ENGIN, CONTAINMENT,
C-0735-76	DESIGN AND ENGIN, CONTAINMENT,
C-0736-76	DESIGN AND ENGIN, CONTAINMENT,
C-0737-76	DESIGN AND ENGIN, CONTAINMENT,
C-0739-76	DESIGN AND ENGIN, CONTAINMENT,
C-1131-76	DESIGN AND ENGIN, GEN EFFECTS OIL PROSPCT/PROD, CONTINGENCY PLANNING, MONITORING,
C-0649-76	DESIGN AND ENGIN, MONITORING,
C-0652-76	DESIGN AND ENGIN, MONITORING,
C-0659-76	DESIGN AND ENGIN, MONITORING,
C-0661-76	DESIGN AND ENGIN, MONITORING,
C-0666-76	DESIGN AND ENGIN, MONITORING,
C-0668-76	DESIGN AND ENGIN, MONITORING,
C-0670-76	DESIGN AND ENGIN, MONITORING,
C-0671-76	DESIGN AND ENGIN, MONITORING,
C-0656-76	DESIGN AND ENGIN, MONITORING, REMOTE SENSING,
C-0657-76	DESIGN AND ENGIN, MONITORING, REMOTE SENSING,
C-0658-76	DESIGN AND ENGIN, MONITORING, U.S. LEG,
C-0673-76	DESIGN AND ENGIN, MONITORING, REMOTE SENSING,
C-0675-76	DESIGN AND ENGIN, REMOTE SENSING,
C-0690-76	DESIGN AND ENGIN, REMOTE SENSING,
C-0032-76*	DESIGN AND ENGIN, *SAMPLING,

C-0828-76 DESIGN AND ENGIN, TRANSFER AND TRANSPORT,
C-0806-76 DESIGN AND ENGIN, TRANSFER AND TRANSPORT,
C-0827-76 DESIGN AND ENGIN, TRANSFER AND TRANSPORT,
C-0810-76 DESIGN AND ENGIN, TRANSFER AND TRANSPORT, WASTE TREATMENT/DISPOSAL METHODS, INT LEG, U.S. LEG,
C-0830-76 DESIGN AND ENGIN, WASTE TREATMENT/DISPOSAL METHODS,
C-0931-76 DESIGN AND ENGIN, WASTE TREATMENT/DISPOSAL METHODS, CONTAINMENT,
C-0834-76 DESIGN AND ENGIN, WASTE TREATMENT/DISPOSAL METHODS,
C-0842-76 DESIGN AND ENGIN, WASTE TREATMENT/DISPOSAL METHODS,
C-0845-76 DESIGN AND ENGIN, WASTE TREATMENT/DISPOSAL METHODS,
C-0846-76 DESIGN AND ENGIN, WASTE TREATMENT/DISPOSAL METHODS,
C-0848-76 DESIGN AND ENGIN, WASTE TREATMENT/DISPOSAL METHODS,
C-0849-76 DESIGN AND ENGIN, WASTE TREATMENT/DISPOSAL METHODS,
C-0850-76 DESIGN AND ENGIN, WASTE TREATMENT/DISPOSAL METHODS,
C-0859-76 DESIGN AND ENGIN, WASTE TREATMENT/DISPOSAL METHODS,
C-0869-76 DESIGN AND ENGIN, WASTE TREATMENT/DISPOSAL METHODS,
C-0887-76 DESIGN AND ENGIN, WASTE TREATMENT/DISPOSAL METHODS,
C-0924-76 DESIGN AND ENGIN, WASTE TREATMENT/DISPOSAL METHODS,
C-0901-76 DESIGN AND ENGIN, WASTE TREATMENT/DISPOSAL METHODS, RECLAMATION AND REUSE

C-1043-76 ECON EFFECTS OIL POLLUT,
C-1047-76 ECON EFFECTS OIL POLLUT,
C-0985-76 ECON EFFECTS OIL POLLUT, BIOL EFFECTS OIL POLLUT,
C-0999-76 ECON EFFECTS OIL POLLUT, BIOL EFFECTS OIL POLLUT,
C-1009-76 ECON EFFECTS OIL POLLUT, BIOL EFFECTS OIL POLLUT,
C-0800-76 ECON EFFECTS OIL POLLUT, CLEANUP AND RECOVERY, CONTINGENCY PLANNING, REPORTING,
C-1045-76 ECON EFFECTS OIL POLLUT, CLEANUP AND RECOVERY, FOREIGN LEG, GEN EFFECTS OIL POLLUT,
C-1220-76 ECON EFFECTS OIL POLLUT, FOREIGN LEG,
C-1052-76 ECON EFFECTS OIL POLLUT, GEN EFFECTS OIL POLLUT, BIOL EFFECTS OIL POLLUT, REPORTING, SOCIAL EFFECTS OIL POLLUT,
C-1063-76 ECON EFFECTS OIL POLLUT, GEN EFFECTS OIL POLLUT, INT LEG, SOCIAL EFFECTS OIL POLLUT,
C-1215-76 ECON EFFECTS OIL POLLUT, INT LEG, U.S. LEG,
C-0633-76 ECON EFFECTS OIL POLLUT, REPORTING,
C-0717-76 ECON EFFECTS OIL POLLUT, SOURCE IDENTIFICATION,
C-1046-76 ECON EFFECTS OIL POLLUT, U.S. LEG,
C-1048-76 ECON EFFECTS OIL POLLUT, U.S. LEG, STATE LEG,
C-1199-76 ECON EFFECTS OIL POLLUT, U.S. LEG,
C-1202-76 ECON EFFECTS OIL POLLUT, U.S. LEG,
C-1044-76 ECON EFFECTS OIL POLLUT, WASTE TREATMENT/DISPOSAL METHODS, U.S. LEG,
C-0833-76 ECON EFFECTS OIL POLLUT, WASTE TREATMENT/DISPOSAL METHODS,

C-1107-76 ECON EFFECTS OIL PROSPCT/PROD, BIOL EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT/PROD,

C-1104-76	ECON EFFECTS OIL PROSPCT/PROD, BIOL EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT/PROD,
C-1132-76	ECON EFFECTS OIL PROSPCT/PROD, BIOL EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT/PROD,
C-0808-76	ECON EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT/PROD, TRANSFER AND TRANSPORT,
C-1085-76	ECON EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT/PROD, TRANSFER AND TRANSPORT,
C-1082-76	ECON EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT/PROD, TRANSFER AND TRANSPORT,
C-1094-76	ECON EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT/PROD, TRANSFER AND TRANSPORT,
C-1097-76	ECON EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT/PROD, TRANSFER AND TRANSPORT,
C-1099-76	ECON EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT/PROD, TRANSFER AND TRANSPORT,
C-1103-76	ECON EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT/PROD, TRANSFER AND TRANSPORT,
C-1133-76	ECON EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT/PROD, TRANSFER AND TRANSPORT,
C-1149-76	ECON EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT/PROD, TRANSFER AND TRANSPORT,
C-1151-76	ECON EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT/PROD, TRANSFER AND TRANSPORT,
C-1130-76	ECON EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT/PROD, SOCIAL EFFECTS OIL PROSPCT/PROD,
C-1148-76	ECON EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT/PROD, SOCIAL EFFECTS OIL PROSPCT/PROD,
C-1105-76	ECON EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT/PROD, TRANSFER AND TRANSPORT,
C-1124-76	ECON EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT/PROD, TRANSFER AND TRANSPORT, U.S. LEG,
C-1204-76	ECON EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT/PROD, U.S. LEG,
C-1074-76	ECON EFFECTS OIL PROSPCT/PROD, SOCIAL EFFECTS OIL PROSPCT/PROD,
C-1076-76	ECON EFFECTS OIL PROSPCT/PROD, SOCIAL EFFECTS OIL PROSPCT/PROD,
C-1080-76	ECON EFFECTS OIL PROSPCT/PROD, SOCIAL EFFECTS OIL PROSPCT/PROD,
C-1081-76	ECON EFFECTS OIL PROSPCT/PROD, SOCIAL EFFECTS OIL PROSPCT/PROD,
C-0867-76	ECON EFFECTS OIL PROSPCT/PROD, WASTE TREATMENT/DISPOSAL METHODS,
C-1221-76	FOREIGN LEG, CONTINGENCY PLANNING, GEN EFFECTS OIL POLLUT,
C-1045-76	FOREIGN LEG, ECON EFFECTS OIL POLLUT, CLEANUP AND RECOVERY, GEN EFFECTS OIL POLLUT,
C-1220-76	FOREIGN LEG, ECON EFFECTS OIL POLLUT,
C-1223-76	FOREIGN LEG, GEN EFFECTS OIL POLLUT,

C-1224-76 FOREIGN LEG, GEN EFFECTS OIL POLLUT,
C-1140-76 FOREIGN LEG, GEN EFFECTS OIL PROSPCT/PROD,
C-1222-76 FOREIGN LEG, INT LEG, U.S. LEG,
C-1212-76 FOREIGN LEG, INT LEG,
C-0948-76 FOREIGN LEG, RECLAMATION AND REUSE,
C-0811-76 FOREIGN LEG, TRANSFER AND TRANSPORT,

C-1056-76 GEN EFFECTS OIL POLLUT,
C-1058-76 GEN EFFECTS OIL POLLUT,
C-1060-76 GEN EFFECTS OIL POLLUT,
C-1066-76 GEN EFFECTS OIL POLLUT,
C-1068-76 GEN EFFECTS OIL POLLUT,
C-1069-76 GEN EFFECTS OIL POLLUT,
C-1228-76 GEN EFFECTS OIL POLLUT, BIBLIOGRAPHIES, WASTE TREATMENT/DISPOSAL METHODS,
C-1052-76 GEN EFFECTS OIL POLLUT, BIOL EFFECTS OIL POLLUT, ECON EFFECTS OIL POLLUT, REPORTING, SOCIAL EFFECTS OIL POLLUT,
C-1049-76 GEN EFFECTS OIL POLLUT, BIOL EFFECTS OIL POLLUT, GEN EFFECTS OIL PROSPCT/PROD
C-1059-76 GEN EFFECTS OIL POLLUT, BIOL EFFECTS OIL POLLUT, GEN FATE OF OIL IN THE ENVIRON
C-1067-76 GEN EFFECTS OIL POLLUT, CLEANUP AND RECOVERY,
C-1045-76 GEN EFFECTS OIL POLLUT, ECON EFFECTS OIL POLLUT, CLEANUP AND RECOVERY, FOREIGN LEG,
C-1063-76 GEN EFFECTS OIL POLLUT, ECON EFFECTS OIL POLLUT, INT LEG, SOCIAL EFFECTS OIL POLLUT,
C-1221-76 GEN EFFECTS OIL POLLUT, FOREIGN LEG, CONTINGENCY PLANNING
C-1223-76 GEN EFFECTS OIL POLLUT, FOREIGN LEG,
C-1224-76 GEN EFFECTS OIL POLLUT, FOREIGN LEG,
C-1143-76 GEN EFFECTS OIL POLLUT, GEN EFFECTS OIL PROSPCT/PROD, CONTINGENCY PLANNING,
C-1053-76 GEN EFFECTS OIL POLLUT, GEN FATE OF OIL IN THE ENVIRON,
C-1064-76 GEN EFFECTS OIL POLLUT, GEN FATE OF OIL IN THE ENVIRON, BIOL EFFECTS OIL POLLUT,
C-1054-76 GEN EFFECTS OIL POLLUT, GEN FATE OF OIL IN THE ENVIRON, CONTINGENCY PLANNING, PERSONNEL TRAINING/EDUCATION,
C-1225-76 GEN EFFECTS OIL POLLUT, INDUSTRIAL STANDARDS/GUIDELINES, GEN FATE OF OIL IN THE ENVIRON,
C-1211-76 GEN EFFECTS OIL POLLUT, INT LEG,
C-1217-76 GEN EFFECTS OIL POLLUT, INT LEG, WASTE TREATMENT/DISPOSAL METHODS
C-0911-76 GEN EFFECTS OIL POLLUT, INT LEG, WASTE TREATMENT/DISPOSAL METHODS,
C-1065-76 GEN EFFECTS OIL POLLUT, MONITORING,
C-0660-76 GEN EFFECTS OIL POLLUT, MONITORING,
C-1051-76 GEN EFFECTS OIL POLLUT, PERSONNEL TRAINING/EDUCATION, MONITORING, REPORTING,

C-1173-76	GEN EFFECTS OIL POLLUT, PHYS CHANGES OF OIL IN THE ENVIRON,
C-1057-76	GEN EFFECTS OIL POLLUT, PHYS EFFECTS OIL POLLUT,
C-0631-76	GEN EFFECTS OIL POLLUT, REPORTING,
C-0638-76	GEN EFFECTS OIL POLLUT, REPORTING,
C-0643-76	GEN EFFECTS OIL POLLUT, REPORTING,
C-0645-76	GEN EFFECTS OIL POLLUT, REPORTING,
C-1055-76	GEN EFFECTS OIL POLLUT, REPORTING, PHYS CHANGES OF OIL IN THE ENVIRON
C-1062-76	GEN EFFECTS OIL POLLUT, TRANSFER AND TRANSPORT,
C-1050-76	GEN EFFECTS OIL POLLUT, U.S. LEG, INT LEG,
C-1061-76	GEN EFFECTS OIL POLLUT, WASTE TREATMENT/DISPOSAL METHODS, ANALYSIS, U.S. LEG,
C-1082-76	GEN EFFECTS OIL PROSPCT/PROD,
C-1083-76	GEN EFFECTS OIL PROSPCT/PROD,
C-1084-76	GEN EFFECTS OIL PROSPCT/PROD,
C-1086-76	GEN EFFECTS OIL PROSPCT/PROD,
C-1087-76	GEN EFFECTS OIL PROSPCT/PROD,
C-1088-76	GEN EFFECTS OIL PROSPCT/PROD,
C-1092-76	GEN EFFECTS OIL PROSPCT/PROD,
C-1095-76	GEN EFFECTS OIL PROSPCT/PROD,
C-1096-76	GEN EFFECTS OIL PROSPCT/PROD,
C-1100-76	GEN EFFECTS OIL PROSPCT/PROD,
C-1101-76	GEN EFFECTS OIL PROSPCT/PROD,
C-1102-76	GEN EFFECTS OIL PROSPCT/PROD,
C-1106-76	GEN EFFECTS OIL PROSPCT/PROD,
C-1108-76	GEN EFFECTS OIL PROSPCT/PROD,
C-1111-76	GEN EFFECTS OIL PROSPCT/PROD,
C-1113-76	GEN EFFECTS OIL PROSPCT/PROD,
C-1115-76	GEN EFFECTS OIL PROSPCT/PROD,
C-1156-76	GEN EFFECTS OIL PROSPCT/PROD,
C-1139-76	GEN EFFECTS OIL PROSPCT/PROD,
C-1144-76	GEN EFFECTS OIL PROSPCT/PROD,
C-1145-76	GEN EFFECTS OIL PROSPCT/PROD,
C-1146-76	GEN EFFECTS OIL PROSPCT/PROD,
C-1150-76	GEN EFFECTS OIL PROSPCT/PROD,
C-1118-76	GEN EFFECTS OIL PROSPCT/PROD,
C-1119-76	GEN EFFECTS OIL PROSPCT/PROD,
C-1123-76	GEN EFFECTS OIL PROSPCT/PROD,
C-1125-76	GEN EFFECTS OIL PROSPCT/PROD,
C-1128-76	GEN EFFECTS OIL PROSPCT/PROD,
C-1129-76	GEN EFFECTS OIL PROSPCT/PROD,
C-1229-76	GEN EFFECTS OIL PROSPCT/PROD, BIBLIOGRAPHIES,
C-1232-76	GEN EFFECTS OIL PROSPCT/PROD, BIBLIOGRAPHIES,
C-1235-76	GEN EFFECTS OIL PROSPCT/PROD, BIBLIOGRAPHIES, MONITORING
C-1093-76	GEN EFFECTS OIL PROSPCT/PROD, BIOL EFFECTS OIL POLLUT,
C-1154-76	GEN EFFECTS OIL PROSPCT/PROD, BIOL EFFECTS OIL POLLUT, CHEM EFFECTS OIL POLLUT, STATE LEG,
C-1098-76	GEN EFFECTS OIL PROSPCT/PROD, BIOL EFFECTS OIL POLLUT,

PHYS EFFECTS OIL POLLUT,
C-1091-76 GEN EFFECTS OIL PROSPCT/PROD, BIOL EFFECTS OIL PROSPCT /PROD
C-1110-76 GEN EFFECTS OIL PROSPCT/PROD, BIOL EFFECTS OIL PROSPCT /PROD
C-1116-76 GEN EFFECTS OIL PROSPCT/PROD, BIOL EFFECTS OIL PROSPCT /PROD
C-1136-76 GEN EFFECTS OIL PROSPCT/PROD, BIOL EFFECTS OIL PROSPCT /PROD
C-1152-76 GEN EFFECTS OIL PROSPCT/PROD, BIOL EFFECTS OIL PROSPCT /PROD
C-1153-76 GEN EFFECTS OIL PROSPCT/PROD, BIOL EFFECTS OIL PROSPCT /PROD
C-1107-76 GEN EFFECTS OIL PROSPCT/PROD, BIOL EFFECTS OIL PROSPCT /PROD, ECON EFFECTS OIL PROSPCT/PROD
C-1104-76 GEN EFFECTS OIL PROSPCT/PROD, BIOL EFFECTS OIL PROSPCT /PROD, ECON EFFECTS OIL PROSPCT/PROD
C-1122-76 GEN EFFECTS OIL PROSPCT/PROD, CLEANUP AND RECOVERY,
C-1137-76 GEN EFFECTS OIL PROSPCT/PROD, CLEANUP AND RECOVERY,
C-1090-76 GEN EFFECTS OIL PROSPCT/PROD, CLEANUP AND RECOVERY, BIOL EFFECTS OIL POLLUT,
C-1131-76 GEN EFFECTS OIL PROSPCT/PROD, CONTINGENCY PLANNING, DESIGN AND ENGIN, MONITORING,
C-1085-76 GEN EFFECTS OIL PROSPCT/PROD, ECON EFFECTS OIL PROSPCT /PROD
C-1089-76 GEN EFFECTS OIL PROSPCT/PROD, ECON EFFECTS OIL PROSPCT /PROD
C-1094-76 GEN EFFECTS OIL PROSPCT/PROD, ECON EFFECTS OIL PROSPCT /PROD
C-1097-76 GEN EFFECTS OIL PROSPCT/PROD, ECON EFFECTS OIL PROSPCT /PROD
C-1099-76 GEN EFFECTS OIL PROSPCT/PROD, ECON EFFECTS OIL PROSPCT /PROD
C-1103-76 GEN EFFECTS OIL PROSPCT/PROD, ECON EFFECTS OIL PROSPCT /PROD
C-1133-76 GEN EFFECTS OIL PROSPCT/PROD, ECON EFFECTS OIL PROSPCT /PROD
C-1149-76 GEN EFFECTS OIL PROSPCT/PROD, ECON EFFECTS OIL PROSPCT /PROD
C-1151-76 GEN EFFECTS OIL PROSPCT/PROD, ECON EFFECTS OIL PROSPCT /PROD,
C-1132-76 GEN EFFECTS OIL PROSPCT/PROD, ECON EFFECTS OIL PROSPCT /PROD, BIOL EFFECTS OIL PROSPCT/PROD,
C-1130-76 GEN EFFECTS OIL PROSPCT/PROD, ECON EFFECTS OIL PROSPCT /PROD, SOCIAL EFFECTS OIL PROSPCT/PROD,
C-1148-76 GEN EFFECTS OIL PROSPCT/PROD, ECON EFFECTS OIL PROSPCT /PROD, SOCIAL EFFECTS OIL PROSPCT/PROD,
C-1105-76 GEN EFFECTS OIL PROSPCT/PROD, ECON EFFECTS OIL PROSPCT /PROD, TRANSFER AND TRANSPORT,
C-1124-76 GEN EFFECTS OIL PROSPCT/PROD, ECON EFFECTS OIL PROSPCT /PROD, TRANSFER AND TRANSPORT, U.S. LEG,

C-1140-76	GEN EFFECTS OIL PROSPCT/PROD, FOREIGN LEG,
C-1049-76	GEN EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL POLLUT, BIOL EFFECTS OIL POLLUT,
C-1143-76	GEN EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL POLLUT, CONTINGENCY PLANNING,
C-1126-76	GEN EFFECTS OIL PROSPCT/PROD, GEN FATE OF OIL IN THE ENVIRON, CLEANUP AND RECOVERY, CONTINGENCY PLANNING,
C-1155-76	GEN EFFECTS OIL PROSPCT/PROD, GEN FATE OF OIL IN THE ENVIRON, TRANSFER AND TRANSPORT,
C-1109-76	GEN EFFECTS OIL PROSPCT/PROD, INDUSTRIAL STANDARDS/ GUIDELINES
C-1226-76	GEN EFFECTS OIL PROSPCT/PROD, INDUSTRIAL STANDARDS/ GUIDELINES,
C-1219-76	GEN EFFECTS OIL PROSPCT/PROD, INT LEG,
C-1072-76	GEN EFFECTS OIL PROSPCT/PROD, PHYS EFFECTS OIL PROSPCT /PROD,
C-0674-76	GEN EFFECTS OIL PROSPCT/PROD, REMOTE SENSING,
C-0646-76	GEN EFFECTS OIL PROSPCT/PROD, REPORTING, INDUSTRIAL STANDARDS/GUIDELINES
C-1138-76	GEN EFFECTS OIL PROSPCT/PROD, SOCIAL EFFECTS OIL PROSPCT/PROD
C-1120-76	GEN EFFECTS OIL PROSPCT/PROD, STATE LEG,
C-1112-76	GEN EFFECTS OIL PROSPCT/PROD, TRANSFER AND TRANSPORT,
C-1121-76	GEN EFFECTS OIL PROSPCT/PROD, TRANSFER AND TRANSPORT,
C-1127-76	GEN EFFECTS OIL PROSPCT/PROD, TRANSFER AND TRANSPORT,
C-1141-76	GEN EFFECTS OIL PROSPCT/PROD, TRANSFER AND TRANSPORT,
C-0819-76	GEN EFFECTS OIL PROSPCT/PROD, TRANSFER AND TRANSPORT,
C-0808-76	GEN EFFECTS OIL PROSPCT/PROD, TRANSFER AND TRANSPORT, ECON EFFECTS OIL PROSPCT/PROD
C-0818-76	GEN EFFECTS OIL PROSPCT/PROD, TRANSFER AND TRANSPORT, WASTE TREATMENT/DISPOSAL METHODS,
C-1134-76	GEN EFFECTS OIL PROSPCT/PROD, U.S. LEG,
C-1135-76	GEN EFFECTS OIL PROSPCT/PROD, U.S. LEG,
C-1142-76	GEN EFFECTS OIL PROSPCT/PROD, U.S. LEG,
C-1191-76	GEN EFFECTS OIL PROSPCT/PROD, U.S. LEG,
C-1197-76	GEN EFFECTS OIL PROSPCT/PROD, U.S. LEG,
C-1206-76	GEN EFFECTS OIL PROSPCT/PROD, U.S. LEG,
C-1207-76	GEN EFFECTS OIL PROSPCT/PROD, U.S. LEG,
C-1208-76	GEN EFFECTS OIL PROSPCT/PROD, U.S. LEG,
C-1204-76	GEN EFFECTS OIL PROSPCT/PROD, U.S. LEG, ECON EFFECTS OIL PROSPCT/PROD
C-1205-76	GEN EFFECTS OIL PROSPCT/PROD, U.S. LEG, STATE LEG,
C-1114-76	GEN EFFECTS OIL PROSPCT/PROD, U.S. LEG, TRANSFER AND TRANSPORT
C-1147-76	GEN EFFECTS OIL PROSPCT/PROD, U.S. LEG, TRANSFER AND TRANSPORT
C-1195-76	GEN EFFECTS OIL PROSPCT/PROD, U.S. LEG, TRANSFER AND TRANSPORT
C-1193-76	GEN EFFECTS OIL PROSPCT/PROD, U.S. LEG, TRANSFER AND TRANSPORT,
C-0876-76	GEN EFFECTS OIL PROSPCT/PROD, WASTE TREATMENT/DISPOSAL

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C-1117-76 GEN EFFECTS OIL PROSPCT/PROD, WASTE TREATMENT/DISPOSAL METHODS
C-1179-76 GEN FATE OF OIL IN THE ENVIRON,
C-1180-76 GEN FATE OF OIL IN THE ENVIRON,
C-1181-76 GEN FATE OF OIL IN THE ENVIRON,
C-1182-76 GEN FATE OF OIL IN THE ENVIRON,
C-1184-76 GEN FATE OF OIL IN THE ENVIRON,
C-1186-76 GEN FATE OF OIL IN THE ENVIRON,
C-0706-76 GEN FATE OF OIL IN THE ENVIRON, ANALYSIS, BIBLIOGRAPHIES, BIOL EFFECTS OIL POLLUT, REPORTING,
C-0703-76 GEN FATE OF OIL IN THE ENVIRON, ANALYSIS,
C-0712-76 GEN FATE OF OIL IN THE ENVIRON, ANALYSIS,
C-0975-76 GEN FATE OF OIL IN THE ENVIRON, BIOL EFFECTS OIL POLLUT,
C-0970-76 GEN FATE OF OIL IN THE ENVIRON, BIOL EFFECTS OIL POLLUT, ANALYSIS,
C-0991-76 GEN FATE OF OIL IN THE ENVIRON, BIOL EFFECTS OIL POLLUT, PHYS CHANGES OF OIL IN THE ENVIRON,
C-1059-76 GEN FATE OF OIL IN THE ENVIRON, GEN EFFECTS OIL POLLUT, BIOL EFFECTS OIL POLLUT,
C-1053-76 GEN FATE OF OIL IN THE ENVIRON, GEN EFFECTS OIL POLLUT,
C-1064-76 GEN FATE OF OIL IN THE ENVIRON, GEN EFFECTS OIL POLLUT, BIOL EFFECTS OIL POLLUT,
C-1054-76 GEN FATE OF OIL IN THE ENVIRON, GEN EFFECTS OIL POLLUT, CONTINGENCY PLANNING, PERSONNEL TRAINING/EDUCATION
C-1126-76 GEN FATE OF OIL IN THE ENVIRON, GEN EFFECTS OIL PROSPCT/PROD, CLEANUP AND RECOVERY, CONTINGENCY PLANNING,
C-1155-76 GEN FATE OF OIL IN THE ENVIRON, GEN EFFECTS OIL PROSPCT/PROD, TRANSFER AND TRANSPORT,
C-1225-76 GEN FATE OF OIL IN THE ENVIRON, INDUSTRIAL STANDARDS/GUIDELINES, GEN EFFECTS OIL POLLUT,
C-0651-76 GEN FATE OF OIL IN THE ENVIRON, MONITORING,
C-0071-76* GEN FATE OF OIL IN THE ENVIRON, *MONITORING, PHYS CHANGES OF OIL IN THE ENVIRON,
C-0035-76* GEN FATE OF OIL IN THE ENVIRON, *PHYS CHANGES OF OIL IN THE ENVIRON, MONITORING,
C-0030-76* GEN FATE OF OIL IN THE ENVIRON, *MONITORING, SAMPLING, ANALYSIS,
C-0046-76* GEN FATE OF OIL IN THE ENVIRON, *MONITORING, SAMPLING, ANALYSIS,
C-1178-76 GEN FATE OF OIL IN THE ENVIRON, PHYS CHANGES OF OIL IN THE ENVIRON,
C-1183-76 GEN FATE OF OIL IN THE ENVIRON, PHYS CHANGES OF OIL IN THE ENVIRON,
C-1185-76 GEN FATE OF OIL IN THE ENVIRON, PHYS CHANGES OF OIL IN THE ENVIRON,
C-1172-76 GEN FATE OF OIL IN THE ENVIRON, PHYS CHANGES OF OIL IN THE ENVIRON,
C-1177-76 GEN FATE OF OIL IN THE ENVIRON, PHYS CHANGES OF OIL IN

	THE ENVIRON,
C-0635-76	GEN FATE OF OIL IN THE ENVIRON, REPORTING,
C-0640-76	GEN FATE OF OIL IN THE ENVIRON, REPORTING,
C-1187-76	GEN FATE OF OIL IN THE ENVIRON, SOURCE IDENTIFICATION, CLEANUP AND RECOVERY,
C-0727-76	GEN FATE OF OIL IN THE ENVIRON, SOURCE IDENTIFICATION, ANALYSIS,
C-0720-76	GEN FATE OF OIL IN THE ENVIRON, SOURCE IDENTIFICATION, GEN FATE OF OIL IN THE ENVIRON,ANALYSIS,
C-1109-76	INDUSTRIAL STANDARDS/GUIDELINES, GEN EFFECTS OIL PROSPCT/PROD,
C-1226-76	INDUSTRIAL STANDARDS/GUIDELINES, GEN EFFECTS OIL PROSPCT/PROD,
C-1225-76	INDUSTRIAL STANDARDS/GUIDELINES, GEN FATE OF OIL IN THE ENVIRON, GEN EFFECTS OIL POLLUT,
C-1227-76	INDUSTRIAL STANDARDS/GUIDELINES, INT LEG, TRANSFER AND TRANSPORT,
C-0646-76	INDUSTRIAL STANDARDS/GUIDELINES, REPORTING, GEN EFFECTS OIL PROSPCT/PROD,
C-0634-76	INDUSTRIAL STANDARDS/GUIDELINES, REPORTING,
C-1189-76	INDUSTRIAL STANDARDS/GUIDELINES, STATE LEG, WASTE
C-0813-76	INDUSTRIAL STANDARDS/GUIDELINES, TRANSFER AND TRANSPORT, TREATMENT/DISPOSAL METHODS,
C-1214-76	INT LEG,
C-1216-76	INT LEG,
C-1212-76	INT LEG, FOREIGN LEG,
C-1222-76	INT LEG, FOREIGN LEG, U.S. LEG,
C-1063-76	INT LEG, GEN EFFECTS OIL POLLUT, ECON EFFECTS OIL POLLUT, SOCIAL EFFECTS OIL POLLUT,
C-1053-76	INT LEG, GEN EFFECTS OIL POLLUT, U.S. LEG,
C-1211-76	INT LEG, GEN EFFECTS OIL POLLUT,
C-1217-76	INT LEG, GEN EFFECTS OIL POLLUT, WASTE TREATMENT/ DISPOSAL METHODS,
C-1219-76	INT LEG, GEN EFFECTS OIL PROSPCT/PROD,
C-1227-76	INT LEG, INDUSTRIAL STANDARDS/GUIDELINES, TRANSFER AND TRANSPORT,
C-0077-76*	INT LEG, *MONITORING, SOURCE IDENTIFICATION,
C-0630-76	INT LEG, REPORTING, TRANSFER AND TRANSPORT,
C-1213-76	INT LEG, TRANSFER AND TRANSPORT,
C-0067-76*	INT LEG, TRANSFER AND TRANSPORT, MONITORING,
C-0814-76	INT LEG, TRANSFER AND TRANSPORT,
C-0810-76	INT LEG, TRANSFER AND TRANSPORT, WASTE TREATMENT/ DISPOSAL METHODS, DESIGN AND ENGIN, U.S. LEG,
C-1215-76	INT LEG, U.S. LEG, ECON EFFECTS OIL POLLUT,
C-1203-76	INT LEG, U.S. LEG, REPORTING, BIOL EFFECT OIL POLLUT,
C-1218-76	INT LEG, WASTE TREATMENT/DISPOSAL METHODS, MONITORING,
C-0911-76	INT LEG, WASTE TREATMENT/DISPOSAL METHODS, GEN EFFECTS OIL POLLUT,
C-0891-76	INT LEG, WASTE TREATMENT/DISPOSAL METHODS, U.S. LEG,

C-0653-76 MONITORING,
C-0664-76 MONITORING,
C-0665-76 MONITORING,
C-0669-76 MONITORING,
C-0074-76 MONITORING,
C-0078-76 MONITORING,
C-0042-76* MONITORING, *ANALYSIS,
C-0707-76 MONITORING, ANALYSIS,
C-0655-76 MONITORING, ANALYSIS,
C-0650-76 MONITORING, ANALYSIS, BIOL EFFECTS OIL POLLUT,
C-0663-76 MONITORING, ANALYSIS, SAMPLING,
C-1235-76 MONITORING, BIBLIOGRAPHIES, GEN EFFECTS OIL PROSPCT/PROD,
C-0072-76* MONITORING, *BIOL EFFECTS OIL POLLUT,
C-0054-76* MONITORING, BIOL EFFECTS OIL POLLUT,
C-0667-76 MONITORING, BIOL EFFECTS OIL POLLUT,
C-0649-76 MONITORING, DESIGN AND ENGIN,
C-0652-76 MONITORING, DESIGN AND ENGIN,
C-0659-76 MONITORING, DESIGN AND ENGIN,
C-0661-76 MONITORING, DESIGN AND ENGIN,
C-0666-76 MONITORING, DESIGN AND ENGIN,
C-0668-76 MONITORING, DESIGN AND ENGIN,
C-0670-76 MONITORING, DESIGN AND ENGIN,
C-0671-76 MONITORING, DESIGN AND ENGIN,
C-0656-76 MONITORING, DESIGN AND ENGIN, REMOTE SENSING,
C-0657-76 MONITORING, DESIGN AND ENGIN, REMOTE SENSING,
C-0658-76 MONITORING, DESIGN AND ENGIN, U.S. LEG,
C-1065-76 MONITORING, GEN EFFECTS OIL POLLUT,
C-1051-76 MONITORING, GEN EFFECTS OIL POLLUT, PERSONNEL TRAINING /EDUCATION, REPORTING,
C-0660-76 MONITORING, GEN EFFECTS OIL POLLUT,
C-1131-76 MONITORING, GEN EFFECTS OIL PROSPCT/PROD, CONTINGENCY PLANNING, DESIGN AND ENGIN,
C-0651-76 MONITORING, GEN FATE OF OIL IN THE ENVIRON,
C-0067-76* MONITORING, *INT LEG, TRANSFER AND TRANSPORT,
C-1218-76 MONITORING, INT LEG, WASTE TREATMENT/DISPOSAL METHODS,
C-0077-76* MONITORING, INT LEG, SOURCE IDENTIFICATION,
C-0672-76 MONITORING, PHYS CHANGES OF OIL IN THE ENVIRON,
C-0071-76* MONITORING, PHYS CHANGES OF OIL IN THE ENVIRON, GEN FATE OF OIL IN THE ENVIRON,
C-0035-76* MONITORING, *PHYS CHANGES OF OIL IN THE ENVIRON, GEN FATE OF OIL IN THE ENVIRON,
C-0673-76 MONITORING, REMOTE SENSING, DESIGN AND ENGIN,
C-0676-76 MONITORING, REMOTE SENSING,
C-0677-76 MONITORING, REMOTE SENSING,
C-0680-76 MONITORING, REMOTE SENSING,
C-0686-76 MONITORING, REMOTE SENSING,
C-0688-76 MONITORING, REMOTE SENSING,
C-0691-76 MONITORING, REMOTE SENSING,
C-0636-76 MONITORING, REPORTING, BIOL EFFECTS OIL POLLUT,

	TRANSFER AND TRANSPORT,
C-0648-76	MONITORING, REPORTING, BIBLIOGRAPHIES, SAMPLING,
C-0642-76	MONITORING, REPORTING, SOURCE IDENTIFICATION,
C-0030-76*	MONITORING, SAMPLING, ANALYSIS, GEN FATE OF OIL IN THE ENVIRON,
C-0662-76	MONITORING, SAMPLING,
C-0066-76*	MONITORING, SAMPLING,
C-0046-76*	MONITORING, SAMPLING, ANALYSIS, GEN FATE OF OIL IN THE ENVIRON,
C-0082-76*	MONITORING, SAMPLING, CLEANUP AND RECOVERY,
C-0073-76*	MONITORING, *SAMPLING,
C-0018-76*	MONITORING, *SAMPLING, ANALYSIS,
C-0654-76	MONITORING, SOURCE IDENTIFICATION,
C-0716-76	MONITORING, SOURCE IDENTIFICATION, REMOTE SENSING,
C-0031-76*	MONITORING, U.S. LEG, TRANSFER AND TRANSPORT
C-1209-76	MONITORING, U.S. LEG, CLEANUP AND RECOVERY,

C-0757-76	PERSONNEL TRAINING/EDUCATION, CLEANUP AND RECOVERY, CONTAINMENT, CONTINGENCY PLANNING,
C-0959-76	PERSONNEL TRAINING/EDUCATION, CLEANUP AND RECOVERY,
C-0964-76	PERSONNEL TRAINING/EDUCATION, CONTINGENCY PLANNING,
C-0960-76	PERSONNEL TRAINING/EDUCATION, CONTINGENCY PLANNING,
C-1054-76	PERSONNEL TRAINING/EDUCATION, GEN EFFECTS OIL POLLUT, GEN FATE OF OIL IN THE ENVIRON, CONTINGENCY PLANNING,
C-1051-76	PERSONNEL TRAINING/EDUCATION, GEN EFFECTS OIL POLLUT, MONITORING, REPORTING,

C-1174-76	PHYS CHANGES OF OIL IN THE ENVIRON,
C-1175-76	PHYS CHANGES OF OIL IN THE ENVIRON,
C-1176-76	PHYS CHANGES OF OIL IN THE ENVIRON,
C-0991-76	PHYS CHANGES OF OIL IN THE ENVIRON, BIOL EFFECTS OIL POLLUT, GEN FATE OF OIL IN THE ENVIRON,
C-1173-76	PHYS CHANGES OF OIL IN THE ENVIRON, GEN EFFECTS OIL POLLUT
C-1178-76	PHYS CHANGES OF OIL IN THE ENVIRON, GEN FATE OF OIL IN THE ENVIRON,
C-1183-76	PHYS CHANGES OF OIL IN THE ENVIRON, GEN FATE OF OIL IN THE ENVIRON,
C-1185-76	PHYS CHANGES OF OIL IN THE ENVIRON, GEN FATE OF OIL IN THE ENVIRON,
C-1172-76	PHYS CHANGES OF OIL IN THE ENVIRON, GEN FATE OF OIL IN THE ENVIRON,
C-1177-76	PHYS CHANGES OF OIL IN THE ENVIRON, GEN FATE OF OIL IN THE ENVIRON,
C-0672-76	PHYS CHANGES OF OIL IN THE ENVIRON, MONITORING,
C-0071-76*	PHYS CHANGES OF OIL IN THE ENVIRON, *MONITORING, GEN FATE OF OIL IN THE ENVIRON,
C-0035-76*	PHYS CHANGES OF OIL IN THE ENVIRON, MONITORING, GEN FATE OF OIL IN THE ENVIRON,
C-0695-76	PHYS CHANGES OF OIL IN THE ENVIRON, SAMPLING, REPORTING,

C-0726-76	PHYS CHANGES OF OIL IN THE ENVIRON, SOURCE IDENTIFICATION, ANALYSIS,
C-1040-76	PHYS EFFECTS OIL POLLUT,
C-1057-76	PHYS EFFECTS OIL POLLUT, GEN EFFECTS OIL POLLUT,
C-1098-76	PHYS EFFECTS OIL POLLUT, GEN EFFECTS OIL PROSPCT/PROD, BIOL EFFECTS OIL POLLUT,
C-1073-76	PHYS EFFECTS OIL POLLUT, PHYS EFFECTS OIL PROSPCT/PROD,
C-1072-76	PHYS EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT /PROD,
C-1073-76	PHYS EFFECTS OIL PROSPCT/PROD, PHYS EFFECTS OIL POLLUT,
C-0936-76	RECLAMATION AND REUSE,
C-0937-76	RECLAMATION AND REUSE,
C-0942-76	RECLAMATION AND REUSE,
C-0944-76	RECLAMATION AND REUSE,
C-0945-76	RECLAMATION AND REUSE,
C-0946-76	RECLAMATION AND REUSE,
C-0947-76	RECLAMATION AND REUSE,
C-0949-76	RECLAMATION AND REUSE,
C-0950-76	RECLAMATION AND REUSE,
C-0951-76	RECLAMATION AND REUSE,
C-0952-76	RECLAMATION AND REUSE,
C-0954-76	RECLAMATION AND REUSE,
C-0957-76	RECLAMATION AND REUSE,
C-0958-76	RECLAMATION AND REUSE,
C-0768-76	RECLAMATION AND REUSE, CONTAINMENT, CLEANUP AND RECOVERY, CONTINGENCY PLANNING,
C-0948-76	RECLAMATION AND REUSE, FOREIGN LEG,
C-0943-76	RECLAMATION AND REUSE, WASTE TREATMENT AND DISPOSAL METHODS,
C-0938-76	RECLAMATION AND REUSE, WASTE TREATMENT/DISPOSAL METHODS,
C-0939-76	RECLAMATION AND REUSE, WASTE TREATMENT/DISPOSAL METHODS
C-0940-76	RECLAMATION AND REUSE, WASTE TREATMENT/DISPOSAL METHODS,
C-0941-76	RECLAMATION AND REUSE, WASTE TREATMENT/DISPOSAL METHODS,
C-0953-76	RECLAMATION AND REUSE, WASTE TREATMENT/DISPOSAL METHODS,
C-0955-76	RECLAMATION AND REUSE, WASTE TREATMENT/DISPOSAL METHODS,
C-0956-76	RECLAMATION AND REUSE, WASTE TREATMENT/DISPOSAL METHODS,
C-0857-76	RECLAMATION AND REUSE, WASTE TREATMENT/DISPOSAL METHODS,
C-0864-76	RECLAMATION AND REUSE, WASTE TREATMENT/DISPOSAL METHODS,
C-0873-76	RECLAMATION AND REUSE, WASTE TREATMENT/DISPOSAL METHODS,

C-0883-76 RECLAMATION AND REUSE, WASTE TREATMENT/DISPOSAL METHODS,
C-0888-76 RECLAMATION AND REUSE, WASTE TREATMENT/DISPOSAL METHODS,
C-0890-76 RECLAMATION AND REUSE, WASTE TREATMENT/DISPOSAL METHODS,
C-0895-76 RECLAMATION AND REUSE, WASTE TREATMENT/DISPOSAL METHODS,
C-0918-76 RECLAMATION AND REUSE, WASTE TREATMENT/DISPOSAL METHODS,
C-0932-76 RECLAMATION AND REUSE, WASTE TREATMENT/DISPOSAL METHODS,
C-0901-76 RECLAMATION AND REUSE, WASTE TREATMENT/DISPOSAL METHODS, DESIGN AND ENGIN,

C-0678-76 REMOTE SENSING,
C-0679-76 REMOTE SENSING,
C-0681-76 REMOTE SENSING,
C-0684-76 REMOTE SENSING,
C-0685-76 REMOTE SENSING,
C-0687-76 REMOTE SENSING,
C-0689-76 REMOTE SENSING,
C-0682-76 REMOTE SENSING, ANALYSIS,
C-0683-76 REMOTE SENSING, ANALYSIS,
C-0675-76 REMOTE SENSING, DESIGN AND ENGIN,
C-0690-76 REMOTE SENSING, DESIGN AND ENGIN,
C-0674-76 REMOTE SENSING, GEN EFFECTS OIL PROSPCT/PROD,
C-0656-76 REMOTE SENSING, MONITORING, DESIGN AND ENGIN,
C-0657-76 REMOTE SENSING, MONITORING, DESIGN AND ENGIN,
C-0673-76 REMOTE SENSING, MONITORING, DESIGN AND ENGIN,
C-0676-76 REMOTE SENSING, MONITORING,
C-0677-76 REMOTE SENSING, MONITORING,
C-0680-76 REMOTE SENSING, MONITORING,
C-0686-76 REMOTE SENSING, MONITORING,
C-0688-76 REMOTE SENSING, MONITORING,
C-0691-76 REMOTE SENSING, MONITORING,
C-0692-76 REMOTE SENSING, REPORTING, CONTINGENCY PLANNING,
C-0724-76 REMOTE SENSING, SOURCE IDENTIFICATION, ANALYSIS,
C-0716-76 REMOTE SENSING, SOURCE IDENTIFICATION, MONITORING,

C-0706-76 REPORTING, ANALYSIS, BIBLIOGRAPHIES, BIOL EFFECTS OIL POLLUT, GEN FATE OF OIL IN THE ENVIRON,
C-0697-76 REPORTING, ANALYSIS,
C-0709-76 REPORTING, ANALYSIS,
C-1234-76 REPORTING, BIBLIOGRAPHIES, ANALYSIS, BIOL EFFECTS OIL POLLUT, CLEANUP AND RECOVERY,
C-1008-76 REPORTING, BIOL EFFECTS OIL POLLUT,
C-0647-76 REPORTING, BIOL EFFECTS OIL POLLUT,
C-0644-76 REPORTING, BIOL EFFECTS OIL POLLUT, CLEANUP AND RECOVERY,
C-0636-76 REPORTING, BIOL EFFECTS OIL POLLUT, MONITORING,

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C-0800-76 REPORTING, CLEANUP AND RECOVERY, ECON EFFECTS OIL POLLUT, CONTINGENCY PLANNING,
C-0637-76 REPORTING, CLEANUP AND RECOVERY,
C-0633-76 REPORTING, ECON EFFECTS OIL POLLUT,
C-1052-76 REPORTING, GEN EFFECTS OIL POLLUT, BIOL EFFECTS OIL POLLUT, ECON EFFECTS OIL POLLUT, SOCIAL EFFECTS OIL POLLUT,
C-1051-76 REPORTING, GEN EFFECTS OIL POLLUT, PERSONNEL TRAINING/EDUCATION, MONITORING,
C-1055-76 REPORTING, GEN EFFECTS OIL POLLUT, PHYS CHANGES OF OIL IN THE ENVIRON,
C-0631-76 REPORTING, GEN EFFECTS OIL POLLUT,
C-0638-76 REPORTING, GEN EFFECTS OIL POLLUT,
C-0643-76 REPORTING, GEN EFFECTS OIL POLLUT,
C-0645-76 REPORTING, GEN EFFECTS OIL POLLUT,
C-0646-76 REPORTING, GEN EFFECTS OIL PROSPCT/PROD, INDUSTRIAL STANDARDS/GUIDELINES,
C-0635-76 REPORTING, GEN FATE OF OIL IN THE ENVIRON,
C-0640-76 REPORTING, GEN FATE OF OIL IN THE ENVIRON,
C-0634-76 REPORTING, INDUSTRIAL STANDARDS/GUIDELINES,
C-0648-76 REPORTING, MONITORING, BIBLIOGRAPHIES, SAMPLING,
C-0692-76 REPORTING, REMOTE SENSING, CONTINGENCY PLANNING,
C-0069-76* REPORTING, *SAMPLING,
C-0084-76* REPORTING, *SAMPLING,
C-0043-76* REPORTING, *SAMPLING, ANALYSIS,
C-0695-76 REPORTING, SAMPLING, PHYS CHANGES OF OIL IN THE ENVIRON
C-0050-76* REPORTING, *SAMPLING, SOURCE IDENTIFICATION,
C-0060-76* REPORTING, *SAMPLING, SOURCE IDENTIFICATION,
C-0632-76 REPORTING, SOURCE IDENTIFICATION,
C-0642-76 REPORTING, SOURCE IDENTIFICATION, MONITORING,
C-0639-76 REPORTING, TRANSFER AND TRANSPORT,
C-0630-76 REPORTING, TRANSFER AND TRANSPORT, INT LEG,
C-0823-76 REPORTING, TRANSFER AND TRANSPORT,
C-1203-76 REPORTING, U.S. LEG, BIOL EFFECT OIL POLLUT, INT LEG,
C-0641-76 REPORTING, WASTE TREATMENT/DISPOSAL METHODS,

C-0804-76 RESTORATION,
C-0980-76 RESTORATION, BIOL EFFECTS OIL POLLUT,
C-0803-76 RESTORATION, BIOL EFFECTS OIL POLLUT,
C-0805-76 RESTORATION, BIOL EFFECTS OIL POLLUT,
C-0794-76 RESTORATION, CLEANUP AND RECOVERY, CONTINGENCY PLANNING

C-0693-76 SAMPLING,
C-0029-76* SAMPLING, ANALYSIS,
C-0081-76* SAMPLING, ANALYSIS,
C-0694-76 SAMPLING, CLEANUP AND RECOVERY,
C-0032-76* SAMPLING, DESIGN AND ENGIN,
C-0018-76* SAMPLING, MONITORING, ANALYSIS,

C-0030-76* SAMPLING, *MONITORING, ANALYSIS, GEN FATE OF OIL IN THE ENVIRON,
C-0046-76* SAMPLING, *MONITORING, ANALYSIS, GEN FATE OF OIL IN THE
C-0663-76 SAMPLING, MONITORING, ANALYSIS,
C-0662-76 SAMPLING, MONITORING,
C-0066-76* SAMPLING, *MONITORING,
C-0073-76* SAMPLING, MONITORING, ENVIRON,
C-0082-76* SAMPLING, *MONITORING, CLEANUP AND RECOVERY,
C-0648-76 SAMPLING, REPORTING, MONITORING, BIBLIOGRAPHIES,
C-0069-76* SAMPLING, REPORTING,
C-0084-76* SAMPLING, REPORTING,
C-0043-76* SAMPLING, REPORTING, ANALYSIS,
C-0695-76 SAMPLING, REPORTING, PHYS CHANGES OF OIL IN THE ENVIRON
C-0050-76* SAMPLING, REPORTING, SOURCE IDENTIFICATION,
C-0060-76* SAMPLING, REPORTING, SOURCE IDENTIFICATION,
C-0696-76 SAMPLING, WASTE TREATMENT/DISPOSAL METHODS,
C-0841-76 SAMPLING, WASTE TREATMENT/DISPOSAL METHODS, BIOL EFFECTS OIL POLLUT, ANALYSIS,

C-1075-76 SOCIAL EFFECTS OIL PROSPCT/PROD, CLEANUP AND RECOVERY, CONTINGENCY PLANNING,
C-1076-76 SOCIAL EFFECTS OIL PROSPCT/PROD, ECON EFFECTS OIL PROSPCT/PROD,
C-1080-76 SOCIAL EFFECTS OIL PROSPCT/PROD, ECON EFFECTS OIL PROSPCT/PROD,
C-1081-76 SOCIAL EFFECTS OIL PROSPCT/PROD, ECON EFFECTS OIL PROSPCT/PROD,
C-1074-76 SOCIAL EFFECTS OIL PROSPCT/PROD, ECON EFFECTS OIL PROSPCT/PROD,
C-1130-76 SOCIAL EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT/PROD, ECON EFFECTS OIL PROSPCT/PROD,
C-1148-76 SOCIAL EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT/PROD, ECON EFFECTS OIL PROSPCT/PROD,
C-1138-76 SOCIAL EFFECTS OIL PROSPCT/PROD, GEN EFFECTS OIL PROSPCT/PROD,

C-0699-76 SOURCE IDENTIFICATION, ANALYSIS,
C-0070-76* SOURCE IDENTIFICATION, *ANALYSIS,
C-0718-76 SOURCE IDENTIFICATION, ANALYSIS,
C-0719-76 SOURCE IDENTIFICATION, ANALYSIS,
C-0721-76 SOURCE IDENTIFICATION, ANALYSIS,
C-0722-76 SOURCE IDENTIFICATION, ANALYSIS,
C-0725-76 SOURCE IDENTIFICATION, ANALYSIS,
C-0051-76* SOURCE IDENTIFICATION, *ANALYSIS,
C-0723-76 SOURCE IDENTIFICATION, ANALYSIS,
C-0727-76 SOURCE IDENTIFICATION, ANALYSIS, GEN FATE OF OIL IN THE ENVIRON,
C-0726-76 SOURCE IDENTIFICATION, ANALYSIS, PHYS CHANGES OF OIL IN THE ENVIRON,

C-0724-76	SOURCE IDENTIFICATION, ANALYSIS, REMOTE SENSING,
C-1231-76	SOURCE IDENTIFICATION, BIBLIOGRAPHIES, ANALYSIS,
C-0717-76	SOURCE IDENTIFICATION, ECON EFFECTS OIL POLLUT,
C-1187-76	SOURCE IDENTIFICATION, GEN FATE OF OIL IN THE ENVIRON, CLEANUP AND RECOVERY,
C-0720-76	SOURCE IDENTIFICATION, GEN FATE OF OIL IN THE ENVIRON, ANALYSIS,
C-0077-76*	SOURCE IDENTIFICATION, *MONITORING, INT LEG,
C-0654-76	SOURCE IDENTIFICATION, MONITORING,
C-0716-76	SOURCE IDENTIFICATION, REMOTE SENSING, MONITORING,
C-0632-76	SOURCE IDENTIFICATION, REPORTING,
C-0642-76	SOURCE IDENTIFICATION, REPORTING, MONITORING,
C-0050-76*	SOURCE IDENTIFICATION, *SAMPLING, REPORTING,
C-0060-76*	SOURCE IDENTIFICATION, *SAMPLING, REPORTING,
C-0862-76	SOURCE IDENTIFICATION, WASTE TREATMENT/DISPOSAL METHODS,
C-1188-76	STATE LEG,
C-1048-76	STATE LEG, ECON EFFECTS OIL POLLUT, U.S. LEG,
C-1154-76	STATE LEG, GEN EFFECTS OIL PROSPCT/PROD, BIOL EFFECTS OIL POLLUT, CHEM EFFECTS OIL POLLUT,
C-1120-76	STATE LEG, GEN EFFECTS OIL PROSPCT/PROD,
C-1190-76	STATE LEG, U.S. LEG,
C-1205-76	STATE LEG, U.S. LEG, GEN EFFECTS OIL PROSPCT/PROD,
C-1189-76	STATE LEG, WASTE TREATMENT/DISPOSAL METHODS, INDUSTRIAL STANDARDS/GUIDELINES,
C-0815-76	TRANSFER AND TRANSPORT,
C-0816-76	TRANSFER AND TRANSPORT,
C-0817-76	TRANSFER AND TRANSPORT,
C-0821-76	TRANSFER AND TRANSPORT,
C-0825-76	TRANSFER AND TRANSPORT,
C-0826-76	TRANSFER AND TRANSPORT,
C-0750-76	TRANSFER AND TRANSPORT, CLEANUP AND RECOVERY, CONTAINMENT,
C-0788-76	TRANSFER AND TRANSPORT, CLEANUP AND RECOVERY,
C-0824-76	TRANSFER AND TRANSPORT, CLEANUP AND RECOVERY,
C-0828-76	TRANSFER AND TRANSPORT, DESIGN AND ENGIN,
C-0806-76	TRANSFER AND TRANSPORT, DESIGN AND ENGIN,
C-0827-76	TRANSFER AND TRANSPORT, DESIGN AND ENGIN,
C-0811-76	TRANSFER AND TRANSPORT, FOREIGN LEG,
C-1062-76	TRANSFER AND TRANSPORT, GEN EFFECTS OIL POLLUT,
C-1105-76	TRANSFER AND TRANSPORT, GEN EFFECTS OIL PROSPCT/PROD, ECON EFFECTS OIL PROSPCT/PROD,
C-1124-76	TRANSFER AND TRANSPORT, GEN EFFECTS OIL PROSPCT/PROD, ECON EFFECTS OIL PROSPCT/PROD, U.S. LEG,
C-1155-76	TRANSFER AND TRANSPORT, GEN EFFECTS OIL PROSPCT/PROD, GEN FATE OF OIL IN THE ENVIRON,
C-1112-76	TRANSFER AND TRANSPORT, GEN EFFECTS OIL PROSPCT/PROD,
C-1121-76	TRANSFER AND TRANSPORT, GEN EFFECTS OIL PROSPCT/PROD,
C-1127-76	TRANSFER AND TRANSPORT, GEN EFFECTS OIL PROSPCT/PROD,

C-1141-76	TRANSFER AND TRANSPORT, GEN EFFECTS OIL PROSPCT/PROD,
C-1114-76	TRANSFER AND TRANSPORT, GEN EFFECTS OIL PROSPCT/PROD, U.S. LEG,
C-1147-76	TRANSFER AND TRANSPORT, GEN EFFECTS OIL PROSPCT/PROD, U.S. LEG,
C-0819-76	TRANSFER AND TRANSPORT, GEN EFFECTS OIL PROSPCT/PROD,
C-0808-76	TRANSFER AND TRANSPORT, GEN EFFECTS OIL PROSPCT/PROD, ECON EFFECTS OIL PROSPCT/PROD,
C-0813-76	TRANSFER AND TRANSPORT, INDUSTRIAL STANDARDS/GUIDELINES,
C-1227-76	TRANSFER AND TRANSPORT, INDUSTIRAL STANDARDS/GUIDELINES, INT LEG,
C-1213-76	TRANSFER AND TRANSPORT, INT LEG,
C-0067-76*	TRANSFER AND TRANSPORT, *INT LEG, MONITORING,
C-0814-76	TRANSFER AND TRANSPORT, INT LEG,
C-0031-76*	TRANSFER AND TRANSPORT, *MONITORING, U.S. LEG,
C-0639-76	TRANSFER AND TRANSPORT, REPORTING,
C-0630-76	TRANSFER AND TRANSPORT, REPORTING, INT LEG,
C-0823-76	TRANSFER AND TRANSPORT, REPORTING,
C-0636-76	TRANSFER AND TRANSPORT, REPORTING, MONITORING, BIOL EFFECTS OIL POLLUT,
C-0809-76	TRANSFER AND TRANSPORT, U.S. LEG,
C-0812-76	TRANSFER AND TRANSPORT, U.S. LEG, CONTAINMENT, WASTE TREATMENT/DISPOSAL METHODS,
C-1195-76	TRANSFER AND TRANSPORT, U.S. LEG, GEN EFFECTS OIL PROSPCT/PROD,
C-1196-76	TRANSFER AND TRANSPORT, U.S. LEG,
C-1198-76	TRANSFER AND TRANSPORT, U.S. LEG,
C-1193-76	TRANSFER AND TRANSPORT, U.S. LEG, GEN EFFECTS OIL PROSPCT/PROD,
C-1200-76	TRANSFER AND TRANSPORT, U.S. LEG, WASTE TREATMENT/DISPOSAL METHODS, CONTAINMENT,
C-0807-76	TRANSFER AND TRANSPORT, WASTE TREATMENT/DISPOSAL METHODS,
C-0820-76	TRANSFER AND TRANSPORT, WASTE TREATMENT/DISPOSAL METHODS,
C-0822-76	TRANSFER AND TRANSPORT, WASTE TREATMENT/DISPOSAL METHODS,
C-0810-76	TRANSFER AND TRANSPORT, WASTE TREATMENT/DISPOSAL METHODS, DESIGN AND ENGIN, INT LEG, U.S. LEG,
C-0818-76	TRANSFER AND TRANSPORT, WASTE TREATMENT/DISPOSAL METHODS, GEN EFFECTS OIL PROSPCT/PROD,
C-0855-76	TRANSFER AND TRANSPORT, WASTE TREATMENT/DISPOSAL METHODS,
C-0877-76	TRANSFER AND TRANSPORT, WASTE TREATMENT/DISPOSAL METHODS,
C-1192-76	U.S. LEG,
C-1201-76	U.S. LEG,
C-0962-76	U.S. LEG, CONTINGENCY PLANNING,
C-1210-76	U.S. LEG, CONTINGENCY PLANNING,
C-1046-76	U.S. LEG, ECON EFFECTS OIL POLLUT,

C-1048-76	U.S. LEG, ECON EFFECTS OIL POLLUT, STATE LEG,
C-1044-76	U.S. LEG, ECON EFFECTS OIL POLLUT, WASTE TREATMENT/DISPOSAL METHODS,
C-1199-76	U.S. LEG, ECON EFFECTS OIL POLLUT,
C-1202-76	U.S. LEG, ECON EFFECTS OIL POLLUT,
C-1222-76	U.S. LEG, FOREIGN LEG, INT LEG,
C-1050-76	U.S. LEG, GEN EFFECTS OIL POLLUT, INT LEG,
C-1061-76	U.S. LEG, GEN EFFECTS OIL POLLUT, WASTE TREATMENT/DISPOSAL METHODS, ANALYSIS,
C-1124-76	U.S. LEG, GEN EFFECTS OIL PROSPCT/PROD, ECON EFFECTS OIL PROSPCT/PROD, TRANSFER AND TRANSPORT,
C-1134-76	U.S. LEG, GEN EFFECTS OIL PROSPCT/PROD,
C-1135-76	U.S. LEG, GEN EFFECTS OIL PROSPCT/PROD,
C-1142-76	U.S. LEG, GEN EFFECTS OIL PROSPCT/PROD,
C-1114-76	U.S. LEG, GEN EFFECTS OIL PROSPCT/PROD, TRANSFER AND TRANSPORT,
C-1147-76	U.S. LEG, GEN EFFECTS OIL PROSPCT/PROD, TRANSFER AND TRANSPORT
C-1191-76	U.S. LEG, GEN EFFECTS OIL PROSPCT/PROD,
C-1197-76	U.S. LEG, GEN EFFECTS OIL PROSPCT/PROD,
C-1206-76	U.S. LEG, GEN EFFECTS OIL PROSPCT/PROD,
C-1207-76	U.S. LEG, GEN EFFECTS OIL PROSPCT/PROD,
C-1208-76	U.S. LEG, GEN EFFECTS OIL PROSPCT/PROD,
C-1204-76	U.S. LEG, GEN EFFECTS OIL PROSPCT/PROD, ECON EFFECTS OIL PROSPCT/PROD,
C-1205-76	U.S. LEG, GEN EFFECTS OIL PROSPCT/PROD, STATE LEG,
C-1195-76	U.S. LEG, GEN EFFECTS OIL PROSPCT/PROD, TRANSFER AND TRANSPORT,
C-1215-76	U.S. LEG, INT LEG, ECON EFFECTS OIL POLLUT,
C-0658-76	U.S. LEG, MONITORING, DESIGN AND ENGIN,
C-0031-76*	U.S. LEG, *MONITORING, TRANSFER AND TRANSPORT
C-1209-76	U.S. LEG, MONITORING, CLEANUP AND RECOVERY,
C-1203-76	U.S. LEG, REPORTING, BIOL EFFECT OIL POLLUT, INT LEG,
C-1190-76	U.S. LEG, STATE LEG,
C-0809-76	U.S. LEG, TRANSFER AND TRANSPORT,
C-0810-76	U.S. LEG, TRANSFER AND TRANSPORT, WASTE TREATMENT/DISPOSAL METHODS, DESIGN AND ENGIN, INT LEG,
C-0812-76	U.S. LEG, TRANSFER AND TRANSPORT, CONTAINMENT, WASTE TREATMENT/DISPOSAL METHODS,
C-1196-76	U.S. LEG, TRANSFER AND TRANSPORT,
C-1198-76	U.S. LEG, TRANSFER AND TRANSPORT,
C-1193-76	U.S. LEG, TRANSFER AND TRANSPORT, GEN EFFECTS OIL PROSPCT/PROD,
C-1200-76	U.S. LEG, TRANSFER AND TRANSPORT, WASTE TREATMENT/DISPOSAL METHODS, CONTAINMENT,
C-0891-76	U.S. LEG, WASTE TREATMENT/DISPOSAL METHODS, INT LEG,

C-1194-76	WASTE TREATMENT/DISPOSAL METHODS, U.S.LEG,
C-0831-76	WASTE TREATMENT/DISPOSAL METHODS,
C-0832-76	WASTE TREATMENT/DISPOSAL METHODS,
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C-0934-76	WASTE TREATMENT/DISPOSAL METHODS,
C-0935-76	WASTE TREATMENT/DISPOSAL METHODS,
C-1228-76	WASTE TREATMENT/DISPOSAL METHODS, BIBLIOGRAPHIES, GEN EFFECTS OIL POLLUT,
C-1167-76	WASTE TREATMENT/DISPOSAL METHODS, BIOL DEGRADATION,
C-0854-76	WASTE TREATMENT/DISPOSAL METHODS, BIOL DEGRADATION,
C-0900-76	WASTE TREATMENT/DISPOSAL METHODS, BIOL DEGRADATION,
C-0912-76	WASTE TREATMENT/DISPOSAL METHODS, BIOL DEGRADATION,
C-1161-76	WASTE TREATMENT/DISPOSAL METHODS, BIOL DEGRADATION, CLEANUP AND RECOVERY,
C-0977-76	WASTE TREATMENT/DISPOSAL METHODS, BIOL EFFECTS OIL POLLUT,
C-0841-76	WASTE TREATMENT/DISPOSAL METHODS, BIOL EFFECTS OIL POLLUT, ANALYSIS, SAMPLING,
C-0741-76	WASTE TREATMENT/DISPOSAL METHODS, CLEANUP AND RECOVERY,
C-0747-76	WASTE TREATMENT/DISPOSAL METHODS, CLEANUP AND RECOVERY,
C-0751-76	WASTE TREATMENT/DISPOSAL METHODS, CLEANUP AND RECOVERY,
C-0762-76	WASTE TREATMENT/DISPOSAL METHODS, CLEANUP AND RECOVERY,
C-0770-76	WASTE TREATMENT/DISPOSAL METHODS, CLEANUP AND RECOVERY,
C-0783-76	WASTE TREATMENT/DISPOSAL METHODS, CLEANUP AND RECOVERY,
C-0847-76	WASTE TREATMENT/DISPOSAL METHODS, CLEANUP AND RECOVERY,
C-0896-76	WASTE TREATMENT/DISPOSAL METHODS, CLEANUP AND RECOVERY,
C-0903-76	WASTE TREATMENT/DISPOSAL METHODS, CLEANUP AND RECOVERY,
C-0913-76	WASTE TREATMENT/DISPOSAL METHODS, CLEANUP AND RECOVERY,
C-0922-76	WASTE TREATMENT/DISPOSAL METHODS, CLEANUP AND RECOVERY,
C-0888-76	WASTE TREATMENT/DISPOSAL METHODS, CLEANUP AND RECOVERY, BIOL DEGRADATION,
C-0931-76	WASTE TREATMENT/DISPOSAL METHODS, CONTAINMENT, DESIGN AND ENGIN
C-0837-76	WASTE TREATMENT/DISPOSAL METHODS, CONTINGENCY PLANNING, CLEANUP AND RECOVERY,
C-0830-76	WASTE TREATMENT/DISPOSAL METHODS, DESIGN AND ENGIN,
C-0834-76	WASTE TREATMENT/DISPOSAL METHODS, DESIGN AND ENGIN,
C-0842-76	WASTE TREATMENT/DISPOSAL METHODS, DESIGN AND ENGIN,
C-0845-76	WASTE TREATMENT/DISPOSAL METHODS, DESIGN AND ENGIN,
C-0846-76	WASTE TREATMENT/DISPOSAL METHODS, DESIGN AND ENGIN,
C-0848-76	WASTE TREATMENT/DISPOSAL METHODS, DESIGN AND ENGIN,
C-0849-76	WASTE TREATMENT/DISPOSAL METHODS, DESIGN AND ENGIN,
C-0853-76	WASTE TREATMENT/DISPOSAL METHODS, DESIGN AND ENGIN,
C-0859-76	WASTE TREATMENT/DISPOSAL METHODS, DESIGN AND ENGIN,
C-0869-76	WASTE TREATMENT/DISPOSAL METHODS, DESIGN AND ENGIN,
C-0887-76	WASTE TREATMENT/DISPOSAL METHODS, DESIGN AND ENGIN,
C-0924-76	WASTE TREATMENT/DISPOSAL METHODS, DESIGN AND ENGIN,

C-0901-76	WASTE TREATMENT/DISPOSAL METHODS, DESIGN AND ENGIN, RECLAMATION AND REUSE,
C-1044-76	WASTE TREATMENT/DISPOSAL METHODS, ECON EFFECTS OIL POLLUT, U.S. LEG,
C-0833-76	WASTE TREATMENT/DISPOSAL METHODS, ECON EFFECTS OIL POLLUT,
C-0867-76	WASTE TREATMENT/DISPOSAL METHODS, ECON EFFECTS OIL PROSPCT/PROD,
C-1061-76	WASTE TREATMENT/DISPOSAL METHODS, GEN EFFECTS OIL POLLUT, ANALYSIS, U.S. LEG,
C-0876-76	WASTE TREATMENT/DISPOSAL METHODS, GEN EFFECTS OIL PROSPCT/PROD,
C-1217-76	WASTE TREATMENT/DISPOSAL METHODS, INT LEG, GEN EFFECTS OIL POLLUT,
C-1218-76	WASTE TREATMENT/DISPOSAL METHODS, INT LEG, MONITORING,
C-0911-76	WASTE TREATMENT/DISPOSAL METHODS, INT LEG, GEN EFFECTS OIL POLLUT,
C-0933-76	WASTE TREATMENT/DISPOSAL METHODS, RECLAMATION AND REUSE,
C-0939-76	WASTE TREATMENT/DISPOSAL METHODS, RECLAMATION AND REUSE,
C-0940-76	WASTE TREATMENT/DISPOSAL METHODS, RECLAMATION AND REUSE,
C-0941-76	WASTE TREATMENT/DISPOSAL METHODS, RECLAMATION AND REUSE,
C-0953-76	WASTE TREATMENT/DISPOSAL METHODS, RECLAMATION AND REUSE,
C-0955-76	WASTE TREATMENT/DISPOSAL METHODS, RECLAMATION AND REUSE,
C-0956-76	WASTE TREATMENT/DISPOSAL METHODS, RECLAMATION AND REUSE,
C-0857-76	WASTE TREATMENT/DISPOSAL METHODS, RECLAMATION AND REUSE,
C-0864-76	WASTE TREATMENT/DISPOSAL METHODS, RECLAMATION AND REUSE,
C-0873-76	WASTE TREATMENT/DISPOSAL METHODS, RECLAMATION AND REUSE,
C-0883-76	WASTE TREATMENT/DISPOSAL METHODS, RECLAMATION AND REUSE,
C-0888-76	WASTE TREATMENT/DISPOSAL METHODS, RECLAMATION AND REUSE,
C-0890-76	WASTE TREATMENT/DISPOSAL METHODS, RECLAMATION AND REUSE,
C-0895-76	WASTE TREATMENT/DISPOSAL METHODS, RECLAMATION AND REUSE,
C-0918-76	WASTE TREATMENT/DISPOSAL METHODS, RECLAMATION AND REUSE,
C-0932-76	WASTE TREATMENT/DISPOSAL METHODS, RECLAMATION AND REUSE,
C-0641-76	WASTE TREATMENT/DISPOSAL METHODS, REPORTING,
C-0696-76	WASTE TREATMENT/DISPOSAL METHODS, SAMPLING,

C-0862-76	WASTE TREATMENT/DISPOSAL METHODS, SOURCE IDENTIFICATION,
C-1189-76	WASTE TREATMENT/DISPOSAL METHODS, STATE LEG, INDUSTRIAL STANDARDS/GUIDELINES,
C-0807-76	WASTE TREATMENT/DISPOSAL METHODS, TRANSFER AND TRANSPORT,
C-0822-76	WASTE TREATMENT/DISPOSAL METHODS, TRANSFER AND TRANSPORT,
C-0810-76	WASTE TREATMENT/DISPOSAL METHODS, TRANSFER AND TRANSPORT, DESIGN AND ENGIN, INT LEG, U.S. LEG,
C-0818-76	WASTE TREATMENT/DISPOSAL METHODS, TRANSFER AND TRANSPORT, GEN EFFECTS OIL PROSPCT/PROD,
C-0812-76	WASTE TREATMENT/DISPOSAL METHODS, TRANSFER AND TRANSPORT, U.S. LEG, CONTAINMENT,
C-0855-76	WASTE TREATMENT/DISPOSAL METHODS, TRANSFER AND TRANSPORT,
C-0877-76	WASTE TREATMENT/DISPOSAL METHODS, TRANSFER AND TRANSPORT,
C-0820-76	WASTE TREATMENT/DISPOCAL METHODS, TRANSFER AND TRANSPORT,
C-1200-76	WASTE TREATMENT/DISPOSAL METHODS, U.S. LEG, TRANSFER AND TRANSPORT, CONTAINMENT,
C-0891-76	WASTE TREATMENT/DISPOSAL METHODS, U.S. LEG, INT LEG,

APPENDIX

Periodicals Reviewed

Abstracts on Health Effects of Environmental Pollutants
Alaska Seas and Coasts
Alternatives: Perspectives on Society and Environment
Ambio
American Fisheries Society Transactions
Applied Microbiology
Applied Science & Technology Index
Aquatic Sciences & Fisheries Abstracts
Audubon
Australian Science Index
Berichte der Deutschen Wissenschaftlichen Kommision für Meeresforschung
Biological Abstracts
Bioscience
British Birds
Bulletin of Environmental Contamination and Toxicology
California Water Pollution Control Association Bulletin
Chemical Abstracts
Chemical and Engineering News
Chemical Engineering
Chemical Engineering Progress
Chemical Week
Chemistry in Canada
Chemosphere
Current Contents: Life Sciences
Current Contents: Physical and Chemical Sciences
Deep-Sea Research
Ecolibrium
Ecological Abstracts
Ecological Society of America Bulletin
Ecology Law Quarterly
Energy Review
Environment
Environment Abstracts
Environmental Action
Environmental Health and Pollution Control
Environmental Letters
Environmental Periodicals Bibliography
Environmental Pollution
Environmental Science & Technology
Environmental Technology and Economics
Erdöl und Kohle Erdgas Petrochemie vereinigt mit Brennstoffchemie
Estuarine and Coastal Marine Science
Fuel Abstracts and Current Titles
Government Reports Announcements

IMS Newsletter
India Journal of Environmental Health
Industrial Wastes Information Bulletin
International Aerospace Abstracts
International Journal of Environmental Analytical Chemistry
International Petroleum Abstracts
Journal of Canadian Petroleum Technology
Journal of Chromatography
Journal of Environmental Sciences
Journal of Petroleum Technology
Journal of the Fisheries Research Board of Canada
Limnology and Oceanography
Marine Biological Association of the United Kingdom, Journal
Marine Biology
Marine Chemistry
Marine Fisheries Review
Marine Geology
Marine Newsletter
Marine Pollution Bulletin
Marine Science Contents Tables
Marine Technology Society, Journal
Maritime Research Information Service Abstracts
Massachusetts Audubon
Microbial Ecology
National Fisherman
National Petroleum News
National Research Council, News Report
National Wildlife
Nature
New Technical Books
Nippon Susan Gakkai Shi. Bulletin of the Japanese Society
of Scientific Fisheries
Ocean Engineering
Ocean Industry
Ocean Management
Ocean Oil Weekly Report
Oceanic Abstracts
Oceanus
Offshore
Oil and Gas Journal
Outdoor California
Pacific Oil World
Petroleum Abstracts
Petroleum Engineer International
Petroleum Today
Pollution Abstracts
Pollution Engineering
Proceedings in Print
Resources
Royal Society of London, Proceedings, Series B, Biological Sciences
Science
Science News
Science of the Total Environment

Scientific and Technical Aerospace Reports
Sea Frontiers
Sea Secrets
Sea Technology
Selected References on Environmental Quality
Selected Water Resources Abstracts
Sierra Club, San Francisco, Bulletin
Technical Book Review
The Ecologist
The Engineering Index
The International Journal of Environmental Studies
The Sciences
Underwater Information Bulletin
Underwater Naturalist
Water, Air, and Soil Pollution
Water Pollution Control
Water Pollution Control Federation, Journal
Water Research
Western Fisheries

U.S. Environmental Protection Agency
Industrial Environmental Research Laboratory
Edison, New Jersey 08817

We are requesting your assistance upon receiving this report ("Oil Spill and Oil Pollution Reports, February 1976 - April 1976").

Is the information usable?
Is the format helpful?

We invite your comments and suggestions. Thank you.

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